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Meeting Report: Advanced Fossil Fuels Sector Group Las Vegas, 25 August 1976

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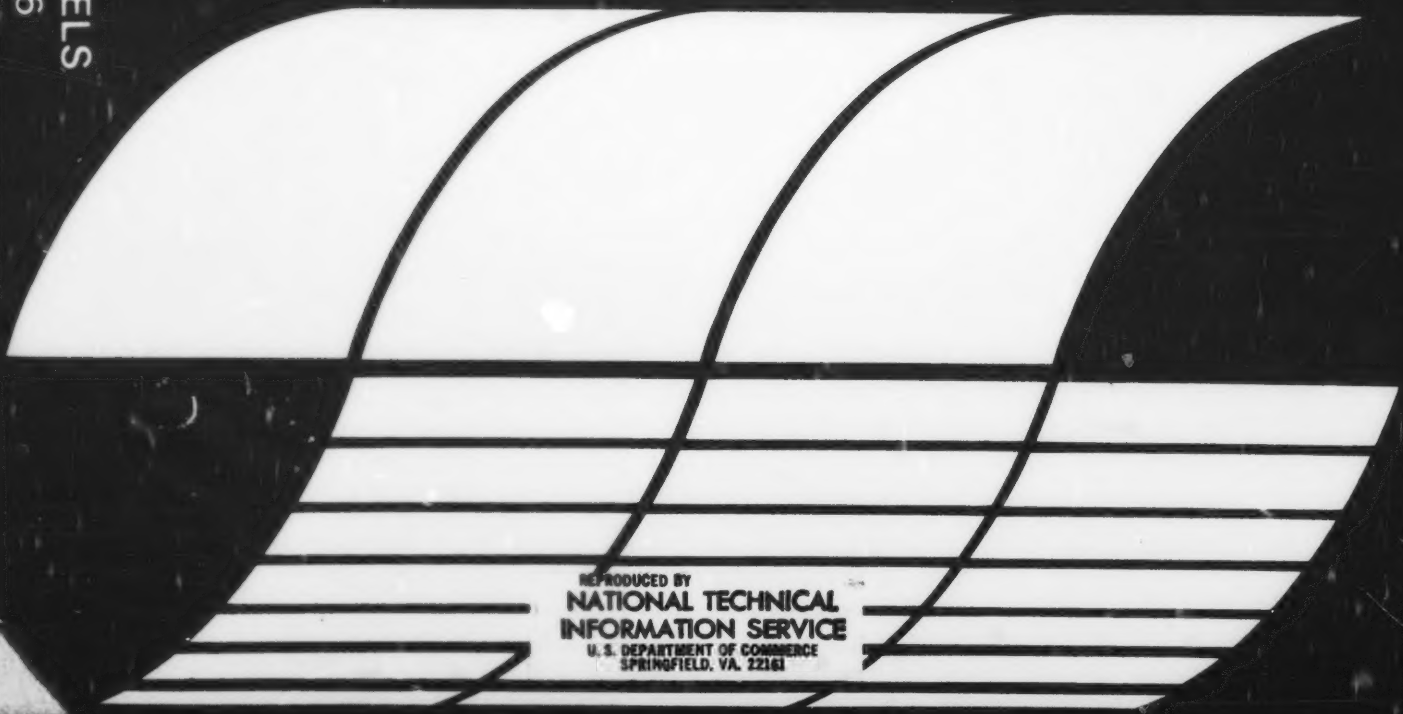
Program Report



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16. ABSTRACT

The minutes of the fourth Advanced Fossil Fuels Sector Group Meeting cover the content of the presentations which were made and the discussion which followed. The general areas of concern were:

(1) Indications of actions taken as a consequence of issues raised at the third Sector Group Meeting; review of OEMI activities related to previous meetings

(2) Review of EPA/ORD Advanced Fossil Fuels Research and Development Program
  (a) Advanced Oil Processing: Chemically Active Fluidized Bed (CAFB) and Desulfurization/Demetallization/Denitrification
  (b) Oil Shale
  (c) Chemical Coal Cleaning
  (d) Synthetic Fuels Environmental Assessment
  (e) Synthetic Fuels Control Technology Development
  (f) High Temperature/High Pressure Particulate Treatment
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ADVANCED FOSSIL FUELS SECTOR GROUP (AFFSG)
LAS VEGAS
25 August 1976

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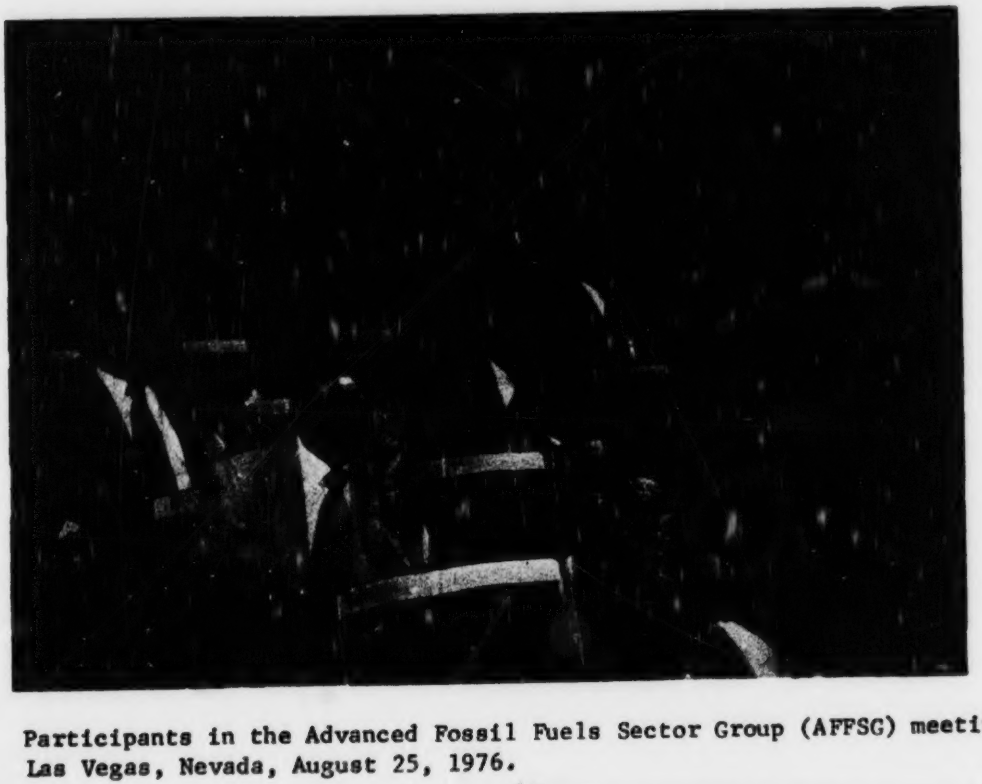
FOREWORD

The Advanced Fossil Fuels Sector Group (AFFSG) is currently composed of approximately 46 members who represent interested groups involved in the advanced fossil fuels research and development (R&D) marketplace--government, and consultants and contractors to the government who are involved in the development of energy conversion technology. Membership includes representatives from the U.S. Environmental Protection Agency (EPA) and all other U.S. government agencies having input to EPA regulatory functions.

The Sector Group serves mainly in a management advisory capacity and also contributes toward assuring that the research, development and demonstration (RD&D) program reflects user requirements through providing input to the planning activities of the Office of Energy, Minerals and Industry (OEMI).

Mr. Kelly Janes (EPA/IERL-RTP) and Mr. William N. McCarthy, Jr. (EPA/OEMI), incoming Sector Group Chairman, at the podium following Mr. Janes' presentation.



Participants in the Advanced Fossil Fuels Sector Group (AFFSG) meeting, Las Vegas, Nevada, August 25, 1976.

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HIGHLIGHTS

ADVANCED FOSSIL FUELS
SECTOR GROUP MEETING

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
LAS VEGAS, NEVADA

25 August 1976

Several topics which received considerable and repeated attention during the Sector Group Meeting and seem to warrant attention by the Executive Committee and/or OEMI staff members for possible recommendations and/or actions are:

- Importance of Sampling
- Potential for Foreign Plant Data Utilization
- Standards Setting Considerations
- Interagency/International Cooperation/Coordination
- Economic Factors in Fossil Fuels Technology Development

IMPORTANCE OF SAMPLING

The necessity for the importance of sampling and the handling of samples in developing control technology (CT) for potential synthetic fuel production facilities has been raised at each Sector Group meeting. Some of the cogent points made at the Las Vegas meeting were:

- Samples are a major concern of both the agencies involved and industry.
- A centralized materials repository was suggested to avoid duplication, and is under consideration.

Following Mr. Christianson's presentation, Dr. David Coffin of EPA's Health Effects Research Laboratory in Research Triangle Park stated that the greatest problem encountered to date has been that of obtaining specimens, with the result that evaluation of the biological effects is out of phase with the engineering. (See p. 67.)

There is an effort underway by EPA, ERDA and NIOSH to set up a cooperative program to collect samples (including shale) for a materials repository. It would provide:

- Standard reference materials
- Sufficient numbers of identical samples to permit interested agencies to work with the same materials.

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Several points which were made with regard to foreign plant sample collection in the discussion following Mr. Rhodes' presentation on Synthetic Fuels Environmental Assessment are applicable to domestic sample collection as well. *There should be a cooperative effort in planning how to obtain and utilize samples--the mechanisms for obtaining them and the kind of data sought.** For such a program to work, all parties concerned must have confidence in the program.

POTENTIAL FOR FOREIGN PLANT DATA UTILIZATION

It was generally agreed that acquisition of information from foreign operations is highly desirable and worthwhile.

Specific foreign installations discussed were:

- Yugoslavia's Kosovo coal gasification plant. (See McCarthy, p. 28). Participants felt that this was an excellent opportunity to gather data and should be encouraged. The gasifier's waste water system is poorly designed from the water pollution point of view. EPA plans to make a thorough measurement of the contents of the plant's waste streams in the future.

- South Africa's SASOL gasification plant. (See General Discussion, p. 71 and Rhodes, p. 82). This plant has been operating 20 years, is large, technically well staffed, and employs a good deal of CT, including a very good water treatment plant. It was suggested that the politically sensitive situation not be allowed to preclude acquisition of data from this advanced facility and it was pointed out that some U.S. commercial groups have politically free access to SASOL, which could facilitate an industry-government approach if a government-government approach should prove infeasible.

- USSR's shale oil development in Estonia. (See Christianson, p. 68 .) The shale oil industry in Estonia has proven viable, supplying most of the electric power to the city of Leningrad and its environs. A joint EPA/NIOSH trip is planned for January 1977 to survey plants, identify points of human contact with effluents and plan health studies.

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* Italics indicate possible issues and/or policy implications.

There have been discussions between EPA and NIOSH relative to a possible joint program to explore both health and environmental data with foreign interests, but NIOSH's specific needs have not yet been delineated.

Battelle has prepared a report covering published information on chemical coal cleaning techniques (both those which have been demonstrated and those under study) around the world.

Some considerations that were raised regarding data collection from foreign sources included:

- Transferability of technology was questionable in some instances, e.g., European shale is two to three times as rich as U.S. shale and thus portions of that technology may not apply.
- U.S. retrofitting of foreign plants--Diversion of a part of a stream of an existing foreign plant for CT study would be a possibility. Foreign plant personnel are well aware of potential pollution problems, although they may be less aggressive than the United States in seeking solutions.
- Problems involved in foreign plant utilization include: cost of retrofit, distance and control.

In utilization of foreign plants, the expense of retrofitting an operating plant with a new technology must be weighed against other alternatives.

In view of these factors, *the tradeoffs between U.S. investment in overseas operations versus building a universal test site here in the United States to address CT problems was brought up as an issue.*

STANDARDS SETTING CONSIDERATIONS

Industry representatives cautioned that *final standards should not be set for an infant industry, since they are not easily changed, once set, and may preclude the development of an economically feasible technology.*

Dr. Coffin considered it desirable, however, to get into a developing industry before major capital investments have been made to obviate serious toxicological problems that might arise.

Relative merits of bench scale and pilot plants were discussed. The need and ability to exercise extreme flexibility in bench scale operation was brought out and compared with the likelihood of inflexibility once a technology reached pilot plant scale. *Mr. John Talty of NIOSH expressed concern that much of the industrial health data from pilot facilities may be atypical, and therefore not fully adequate for use in addressing health problems.*

Robert Bauman (EPA/Office of Air Quality Planning and Standards) indicated that there is no program to set particulate standards at present.

INTERAGENCY/INTERNATIONAL COORDINATION/COOPERATION

Interagency

Sector Group participants seemed to feel that there was cause for optimism in this area, that there has been a steady increase in communication and cooperation, expecially between EPA. ERDA and NIOSH. The importance of continuing and increasing this cooperation was stressed. It was pointed out that work done by one agency should reflect ongoing work in other agencies, avoiding even the appearance of duplication of effort. EPA, ERDA, NIOSH, the Department of the Interior and others are involved in different aspects of the same areas (e.g., both ERDA and Interior are concerned with in-situ studies). ERDA is mandated to develop environmentally sound technologies; EPA, to environmentally assess technologies developed by others. NIOSH has a regulatory role similar to EPA, but geared specifically to health aspects and with a different legislative base.

There are efforts being made by EPA, ERDA and NIOSH to draw up memoranda of understanding, protocols, or agreements to develop joint programs where possible.

EPA/OEMI and ERDA/Environment and Safety are cooperating in the area of waste disposal.

Coordination in sample collections should facilitate the cooperation of technology developers, both domestic and foreign.

International

The USA/USSR Interagency International Program involves assessment of plants to determine where health effects should be studied, and how to interact with the plant staff. This program offers a precedent for interaction that could be spread to other programs with relative ease.

ECONOMIC FACTORS IN FOSSIL FUELS TECHNOLOGY DEPARTMENT

Cost benefit tradeoff considerations were brought up throughout the presentations and discussions indicated a great deal of concern with the economic factors involved in the programs.*

TRW/Meyers Chemical Coal Cleaning Process

In discussion the Meyers process, it was indicated that funding should be available to complete the reactor test unit (RTU). Efforts are, however, underway to reduce the reaction cost through more effective processing.

EPA representatives expressed the opinion that funding for such studies should come from an agency other than EPA, e.g., Bureau of Mines or ERDA. *It was pointed out that there is little incentive for producers to fund such testing, since additional cleaning costs would have to be added to consumer costs, rendering their product less competitive with that of producers complying with minimum standards.*

Attempts have been made to measure the economics of the Meyers process vs. alternative cleaning technologies. The process is apparently significantly less costly than Battelle's process, although there was some question as to their comparability. It is competitive with flue gas desulfurization (FGD), although chemical coal cleaning should prove less expensive for the smaller industrial or commercial use since the cost of

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* In discussions among Sector Group Members during meeting breaks, considerable concern was expressed concerning the fact that *tax incentives are not now available for pretreatment efforts such as coal cleaning*. See also, footnote on p.

FCD Control Technology is percentage wise, proportionally greater as systems become smaller. This suggests a crossover point at which chemical coal cleaning would become cost effective.

Chemically Active Fluid Bed (CAFB)

As of the last evaluation, it appeared that CAFB costs are competitive with flue gas desulfurization techniques when applied to high sulfur oils, although little has been said about the economic aspects because of the rather rapidly varying economic situation with regard to energy costs and availability and costs of retrofitting.

EXECUTIVE SUMMARY OF MINUTES
ADVANCED FOSSIL FUELS
SECTOR GROUP MEETING

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
LAS VEGAS, NEVADA

25 August 1976

SESSION I: ACTIVITIES RELATED TO PREVIOUS MEETINGS AND DISCUSSION

Mr. William N. McCarthy, Jr., the Sector Groups Coordinator and incoming AFFSG Chairman, introduced the outgoing Chairman, Dr. Gary J. Foley, who has accepted a post in Paris, France with the Organisation for Economic Co-operation and Development. Dr. Foley welcomed the AFFSG members and members from the Electric Utilities Working Sector Group (EUWSG).

Mr. McCarthy summarized current Sector Group activities which include efforts to:

- Prioritize pollutants,
- Publicize the cooperative effort underway with the Yugoslavs at their Kosovo coal gasification plant,
- Promote EPA-ERDA interaction,
- Publicize the Meyers coal cleaning process,
- Promote information transfer on national oil shale efforts, and,
- Update on a continuous basis the problems and programs "Blue Book."

With regard to setting pollutant priorities, Mr. McCarthy reviewed the Sector Group Executive Committee's development of a memorandum to Dr. Gage recommending the establishment of a "Wise-Man Panel". Dr. Gage indicated that this approach was in line with an Office of Research and Development (ORD) recommendation for what might be called a "Wise-Man Task Force", a broader multi-media, multi-disciplined approach. The Task Force may include implementation of the approach suggested by the Sector Group Executive Committee.

Mr. McCarthy then reported in detail on the EPA trip to the Kosovo coal gasification plant in Pristina, Yugoslavia and plans for a Yugoslav team to visit the United States.

He presented a brief update of EPA-ERDA interaction: EPA visits to ERDA demonstration plants, plans for joint environmental testing, exchange of information on ongoing and planned projects and EPA provision of

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membership on ERDA task forces for the development and analysis of the Coalcon process.

In the area of Standards, Mr. McCarthy indicated the status of new source performance standards (NSPS) for coal gasification plants. Relating to the gaseous emissions of sulfur and hydrocarbons from coal gasification plants, Mr. McCarthy described the status of the recommended NSPS. No water standards are currently being considered because it is hoped that there will be no liquid discharge.

EPA is proceeding with funding for construction of a Reactor Test Unit (RTU) using the TRW/Meyers process. Mr. McCarthy gave an overall rundown of cost estimates, status, and efforts to make potential users aware of the process.

A cooperative sampling and analysis effort for the oil shale program is underway at the Paraho facility, with participation by TRW, Denver Research Institute (DRI), Paraho Oil Shale Demonstration, Inc., and ERDA's Laramie Energy Research Center (LERC). A related effort to amass an information base on oil shale for Sector Group use includes compilation and distribution of a bibliography, distribution of a Smithsonian Science Information Exchange (SSIE) computer listing of government-funded oil shale R&D projects.

The latest Environmental Problems and Research and Development Program document ("Blue Book") updates were reviewed, with a request for membership evaluation of the usefulness of this book.

Discussion

Two notes of interest brought out in the discussion following Mr. McCarthy's presentation were:

- EPA is helping to support the Fourth National Conference on Energy and the Environment, October 5-7 in Cincinnati. Presentations scheduled for the October 6 morning and afternoon sessions will present the EPA Interagency Coal Cleaning Program's resource aspects and cleaning processes.*

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*A report on these sessions will be available in November, 1976 (EPA-600/7-76-024).

- EPA has a $5 million contract with TRW to design and construct a coal cleaning plant and to perform a one-year test program on the economic feasibility and effectiveness of the process.

SESSION II: EPA/ORD ADVANCED FOSSIL FUELS DEVELOPMENT PROGRAMS

Dr. Gary Foley, Chairman of the meeting, began the second session by urging active audience participation.

A. Advanced Oil Processing: CAFB

Mr. Sam Rakes, OEMI/IERL-RTP, presented an overview of work being done by EPA in advanced oil processing using chemically active fluid bed (CAFB) technology. He gave a brief history of the process from its inception at the ESSO Research Center in England in 1966 to EPA's present involvement, which includes a demonstration plant at the La Palma generating station, San Benito, Texas for the gasification and utilization of high-sulfur residual oil. This demonstration project will be based on a proprietary process for sulfur recovery. It is hoped that the La Palma station will provide reasonable estimates of the economics of the CAFB process for use as yet another control alternative to flue gas desulfurization (FGD).

The effort also addresses possible options available in the handling of spent sorbent. Mr. Rakes pointed out various retrofit difficulties that have been encountered in modifying the San Benito site and how they have been solved. He also indicated several advantages of the CAFB process. Information on CAFB technology is being provided to ERDA and to other interested parties.

The discussion after Mr. Rakes' presentation covered possible utilization of used crankcase oil, the Btu content of the product gas, status of the proprietary Resox process, the economic viability of CAFB and an elaboration of the environmental monitoring program associated with CAFB development.

B. Advanced Oil Processing: Desulfurization/Demetallization Denitrification

Mr. William Rhodes, OEMI/IERL-RTP, summarized other advanced oil processes: desulfurization, demetallization and denitrification. Based on past experience, pretreatment of liquid fuels is expected to be:

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- less expensive than treatment after combustion
- cost effective for smaller area source users
- beneficial to oil refinery operations, and
- applicable to synthetic fuel liquids.

Currently, the thrusts of the programs are the development of improved scavengers for heavy metal contaminants in residual fuels, and the development of removal methods. The proprietary nature of most industrial R&D has been a major problem in relation to such development.

Domestically, a bench scale evaluation is underway with Hydrocarbon Research, Inc. utilizing molybdenum (1%) on activated bauxite as the scavenger prior to conventional hydrodesulfurization (HDS). In the denitrification area, EPA has a research grant with MIT to study hydrodenitrification (HDN) and hydrodesulfurization kinetics and reaction mechanisms on generic compounds. EPA also has a cooperative program with the Soviet Union for pretreatment cross testing which involves Soviet and U.S. catalysts and oils.

The sulfur, nitrogen and metal contents of synthetic liquid fuels and the effectiveness of combustion control techniques are either unknown or unpublished. Simultaneous removal of nitrogen and sulfur appears to be desirable, but extensive research is necessary to determine the feasibility of this approach.

Still in the early stages of this research, there has not, as yet, been much interaction with other programs and agencies, although this will be desirable as work progresses.

Items of interest during the discussion period included the level of program funding (currently about $200K per fiscal year), screening catalysts, application of the scavenger technology to synfuels, the cost of this technology as an alternative or complement to combustion modification, and the availability of data on the nitrogen, sulfur and metals' content of shale and coal oils.

C. Oil Shale

Mr. Alden Christianson (OEMI/IERL-CINC) presented an overview of EPA's oil shale R&D program which includes environmental assessment, control technology development, studies of pollutant transport, ecological effects, health effects and measurement and monitoring.

He emphasized that although oil shale processing is, as yet, essentially nonexistent as an industry, its potential importance stems from the fact that oil shale is one of the United States' largest natural energy resources, second only to coal. The oil shale industry has an uncertain future because of process costs and problems posed by water requirements.

Mr. Christianson described the efforts of the Industrial Environmental Research Laboratory in Cincinnati, both in-house and with TRW/Denver Research Institute (DRI), and Colorado State University (CSU), relating to retorting, emissions characterization and control, solid waste, revegetation, air quality modeling, underground aquifers modeling and socio-economic impacts. A sampling and analysis program has been conducted at ERDA's Paraho facility by TRW. Revegetation and leaching studies are continuing, air quality models are being developed and tested, and meteorological data are being accumulated.

In spite of the fact that the oil shale program has been in a constant state of flux as a result of an undefined national energy policy, congressional indecision, escalating costs and the influence of environmental groups, Mr. Christianson indicated that EPA would continue research efforts on oil shale appropriate to the commercialization potential of the industry. Interagency cooperation in these efforts is necessary, since no single group or interest will likely have either the resources or the capability to do all of what must be done.

In the discussion that followed, Dr. David Coffin, EPA/HERL-RTP, amplified Mr. Christianson's remarks, commenting on planned actions in the health and ecology areas and the advisability of obviating toxicological problems before large capital investments are made. He stressed the difficulties of obtaining specimens and the value of a central repository both as a reference and source of research samples.

Dr. Coffin also informed the group of a USSR/USA cooperative agreement on oil shale development and the health effects problems to be studied.

General Discussion

Advanced oil processing, oil shale, coal gasification and alternative technologies to flue gas desulfurization with emphasis on problems relating to in-situ processing of oil shale were further discussed.

Plant characteristics and considerations of foreign coal gasification efforts and the value of data derived from these efforts received considerable attention.

ERDA, EPA and NIOSH areas of responsibility were indicated, and it was emphasized that the activities spanning several federal agencies should be coordinated in an attempt to avoid unnecessary duplication of effort.

D. Chemical Coal Cleaning

Mr. Kelly Janes, Chief of the Fuel Processing Branch, Energy Assessment and Control Division, IERL-RTP began by explaining that the Coal Cleaning Program differs from other EPA synthetic fuels programs in its responsibility for basic technology development. It is based on the technological development of the process(es), environmental assessment and control technology development (CTD) for the purpose of increasing the size of U.S. coal resources acceptable for meeting emissions regulations, and developing methods of producing a clean fuel for small users. Environmental assessments are intended for any process for which commercialization is intended.

The assessment will include studying the residues from the coal cleaning processes from the environmental point of view.

It is hoped that results from operation of the TRW's Reactor Test Unit (RTU) utilizing the Meyers Process will solve some of the economic uncertainties and disposal problems connected with present knowledge.

Evaluations of techniques are underway and state-of-the-art background documents are being prepared. Possible economic advantages of combining physical and chemical coal cleaning are being considered.

Mr. Janes' presentation elicited extensive discussions related to the completion of the Meyers RTU, preparation techniques and the comparative costs of the available processes.

E. Synthetic Fuels Environmental Assessment

Mr. William Rhodes was reintroduced to discuss the environmental assessment aspects of synthetic fuels from coal liquefaction and low- and high-Btu coal gasification.

He identified the objectives of the program as:

- characterizing and quantifying the environmental aspects of synthetic fuels technology
- determining the applicability and effectiveness of available control technology (CT), and
- identifying needed new CT.

The program consists of (1) review of current technology, (2) acquisition of environmental data, (3) characterization of feedstocks, (4) control technology state-of-the-art, (5) engineering, and environmental and cost analysis.

One problem connected with the program is the limited number of commercial plants, thus requiring data to be acquired from pilot scale units. Another limitation is that the potential for adverse effects to health and the environment from such plants is relatively undefined.

The engineering analysis and technology background portions of the program are completed. The environmental impact statements (EIS) and proposed EPA gasification system standards are now being evaluated.

The Synthetic Fuels Program interacts with other programs within EPA Headquarters and Regions, and has cooperative sampling programs with ERDA, OSHA and NIOSH.

The discussion after Mr. Rhodes' presentation included;

- amplification on bench scale and pilot plant considerations related to pollutant research
- evaluations of foreign plants--planned or in progress--and
- ERDA activities relating to environmental assessments of coal synthetic fuels.

F. Synthetic Fuels Control Technology Development

In his second presentation, Mr. Kelly Janes discussed control technology development (CTD) which makes up the remaining portion of the Synthetic Fuels Program. In this area the program covers:

- water and waste management
- fugitive emissions, coal treatment and feeding
- converter output cleanup and purification, and
- products and byproducts.

The purpose of the CTD program is to: (1) evaluate existing control techniques, (2) modify existing or develop new control techniques as necessary, and (3) perform engineering and cost analyses of alternative control techniques.

Program limitations are similar to those affecting the Environmental Assessment Program:

- lack of commercial facilities
- questionable reliability of pilot plant data when applied to full scale facilities
- undefined, potentially adverse environmental and health effects, and
- although accelerated, uncertain commercialization timetables.

Evaluation of existing technologies is well advanced, but R&D is still in a very early stage.

Problems which are similar to those encountered by the assessment program include: (1) no concerted effort to examine controls, (2) few pilot plant facilities, and (3) the proprietary nature of most existing state-of-the-art techniques. An important consideration is whether or not to build a major test facility designed only to develop better control techniques. A basic question is whether or not the United States should develop systems designed for the fewest environmental problems or the most energy efficient systems, regardless of the control problems resulting.

The Synfuels Program interfaces with EPA's Regional programs, the standards development program and various engineering programs. It is also involved in joint CT work with ERDA and cooperative CT programs at OSHA and NIOSH. Joint programs with industry are desirable, but to date, have been difficult to establish.

The discussion related to facility options for CT development. Among the possibilities suggested were:

- utilization of part of a stream of an existing foreign plant
- construction of a universal test site in the United States
- development of equipment to retrofit existing pilot plants
- reliance on bench scale operations, and
- examination of technology as it is applied in analogous situations.

G. High Temperature/Pressure Particulate Control

Mr. Dennis Drehmel focussed attention on high temperature and pressure (HTP) particulate control. He stressed the point that the Particulate Technology Branch is device rather than process oriented, unlike the other branches within the Industrial Environmental Research Laboratory at RTP.

The two main objectives of the program are:

- to ensure that emissions from advanced energy processes meet future standards, and
- to develop particulate collection devices that will ensure the success of these advanced energy processes.

Development and evaluation of particulate control devices have been going on for some time. These include:

- electrostatic precipitators
- metallic and ceramic fabric filters
- mechanisms for HTP particulate removal, and
- mechanisms based on dry scrubber control.

Finding sufficient time to develop particulate removal techniques to meet EPA requirements in conjunction with ongoing development of processes is a major problem. Particulate removal techniques must be compatible with gasification technology or pressurized fluidized bed combustion. In addition, size and economic constraints and the cost of HTP particulate control devices for bench scale and/or pilot scale facilities must also (and are) being considered.

Work currently in progress is primarily at the bench scale or exploratory level. An R&D coordination meeting between EPA, ERDA and appropriate contractors is planned for the Fall of 1976 and another, to report progress, for the Spring of 1977.

It has been indicated that the high temperature/pressure portion of the process may not be the best place to control particulates. Alternatives are tail-end cleanup or cooling of the gas in order to clean it. However, the gas might subsequently require reheating. Trade-off evaluations are difficult at the current stage of development because of uncertainties. Careful evaluation of ongoing programs are conducted on a continuing basis to determine whether or not the advances being made provide a means of meeting current standards more economically.

Future tasks involve: (1) finding economic levels of particulate removal at gasifier exit temperatures, (2) determination of operating conditions and process requirements and (3) inclusion of health effects research.

In the discussion, Mr. Robert Bauman (EPA, Office of Air Quality, Planning and Standards) indicated that there is, as yet, no program to set particulate standards.

A protocol between EPA and ERDA/Fossil Energy is being negotiated to allow the two agencies to swap facilities on an equal-number-of-test-hours basis.

H. Environmental Processes and Effects

Mr. Gerald Rausa gave an overview of this portion of the interagency program indicating:

- general research objectives within the processes and effects categories
- specific research problems with respect to advanced fossil fuels, and
- accomplishments and difficulties.

The Environmental Processes and Effects Interagency R&D Program addresses:

- pollutant characterization
- measurement and monitoring
- environmental transport processes
- health effects
- ecological effects, and
- integrated assessment.

Although the characterization of sources is the responsibility of the CT program, pollutant characterization, and measurement and monitoring of field or ambient data are under the purview of the Environmental Processes and Effects groups.

The environmental transport processes area covers: (1) rates, (2) routes and (3) reservoirs of pollutants. The health effects area covers: (1) pollutant identification, (2) development of more rapid biological screening, (3) metabolism and fate studies and (4) impact of long-term, low-level exposures on humans and mechanisms of damage and repair. The ecological effects area covers: (1) impact studies on habitats, (2) populations and (3) the food chain pathway.

Integrated assessments, initially managed only from OEMI Headquarters, are now also managed in the two IERL laboratories. The Environmental Processes and Effects Program coordinates these efforts.

The basic problem of the overall Environmental Processes and Effects Program is the extremely difficult development of an index of toxicity for organics because of the large number of complex variables involved.

Other problems include the need for more accurate instrumentation, the measurement of environmental quality trends, the identification of secondary sources, the development of a systematic monitoring methodology and the procurement of surrogate standard reference materials. Currently, a list of standard reference materials is being compiled as a joint effort with ERDA and the National Bureau of Standards. However, it is primarily for calibration of instrumentation rather than for toxicity testing.

Advanced fossil fuels residuals and products are being characterized physically and chemically.

Experiments on directional modeling and shale oil adsorption are ongoing in the transport and fate area, but little has been done to address transformation of organic materials with respect to atmospheric transport. In the case of aquatic transport, the focus is essentially nonspecific with a small effort on transformation being made between solubles and particulate materials.

In the health effects area, products used in carcinogenic-related studies are being screened for toxicity and mutagenicity. For the last two years, EPA, ERDA, the National Institute for Occupational Safety and Health (NIOSH) and the National Institute of Environmental Health Sciences (NIEHS) have been cooperating in a study in the
carcinogenic-related program is now also addressing questions of inorganics and trace metals involvement, including the multiplicity of stressors.

In the ecological effects area there are studies being conducted on: aquatic toxicity, bioaccumulations of metals and organics and food web accumulation and transformation.

During the discussion period Mr. Rausa referred interested persons to an SSIE abstract listing, organized according to the five program categories. He concluded the discussion by asking for comment on possible shifts of emphasis and on problems not being addressed.

The meeting was then adjourned.

MINUTES OF
ADVANCED FOSSIL FUELS SECTOR
GROUP MEETING

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
LAS VEGAS, NEVADA

25 AUGUST 1976

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SESSION I: ACTIVITIES RELATED TO PREVIOUS MEETINGS AND DISCUSSION

Dr. Gary J. Foley, outgoing Chairman of the Advanced Fossil Fuels Sector Group (AFFSG) was introduced by Mr. William N. McCarthy, Jr., who is assuming the chairmanship of the Sector Group.

Dr. Foley welcomed and introduced Sector Group members and visitors, drawing attention to the broad participation of various federal agencies, industries and interest groups in Sector Group activities.

He then asked Mr. McCarthy to present a summary of the ongoing efforts being pursued by the Sector Group.

Introduction

Mr. McCarthy indicated that current Sector Group activities include efforts to prioritize pollutants; publicize the effort underway with the Yugoslav government at their Kosovo facilitiy (which has already had some effects on the Office of Energy, Minerals and Industry's (OEMI) overall program); EPA-Energy Research and Development Administration (ERDA) interaction, specifically that relating to ERDA's coal gasification development plans; publicize the Meyers coal cleaning process; information transfer on national oil shale efforts; and the continuing update of the problems and programs "Blue Book."

Pollutant Prioritization

As a result of discussions at previous meetings relative to ways and means of prioritizing pollutants, the Sector Group sent a memorandum to OEMI Deputy Assistant Administrator, Dr. Stephen Gage, recommending the establishment of a "Wise-Man Panel" to prioritize pollutants in the order of their importance in environmental assessment and development of control technology for synfuel plants.

This recommendation was the result of Sector Group consideration of a number of possible prioritization methods, most of which depend upon information derived from a study of pollutant toxicity or health effects. Since such information requires extended research, it is

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apparent that control technology development (CTD) and perhaps even the establishment of standards for pollutants, will have to precede the completion of this research.

The Sector Group membership generally felt that, under the circumstances, delineation of the major areas of concern could best be accomplished by a "Wise-Man Panel" of senior experts in the pollution field. The panel would consist of 10 line managers from various EPA R&D and regulatory programs that interact with synthetic fuels development. They would meet and compose a list of pollutants to be measured, studied and controlled within the EPA R&D programs, in the order they considered most appropriate from the standpoint of synfuel development plants, both gasification and liquefaction. They would determine which pollutants would be likely to be most detrimental to the commercialization of that industry, and advise the Deputy Assistant Administrators (DAAs) of their findings. With the DAAs' concurrence, these findings would be implemented within their programs.

Dr. Gage considered this approach excellent. However, at about the same time, the Office of Research and Development (ORD) came up with a recommendation for what might be called a "Wise-Man Task Force," a broader multi-media, multi-disciplined approach, directed towards developing a toxic strategy for the agency. So, although the Sector Group did not propose the approach first, Sector Group thinking is in line with that of ORD. The ORD task force has proposed a straw man for developing an agency strategy and a toxic evaluation methodology which will address synfuel toxics on a high priority and which may include implementation of the "wise-man" approach as suggested by the Sector Group.

Yugoslav Plant

Figure 1 shows the Kosovo coal gasification plant in Pristina, Yugoslavia. It is located about midway between and 75 miles from the borders of Albania and Bulgaria, and about 135 miles north of Greece. Several Sector Group members visited the plant June 14-22 to initiate

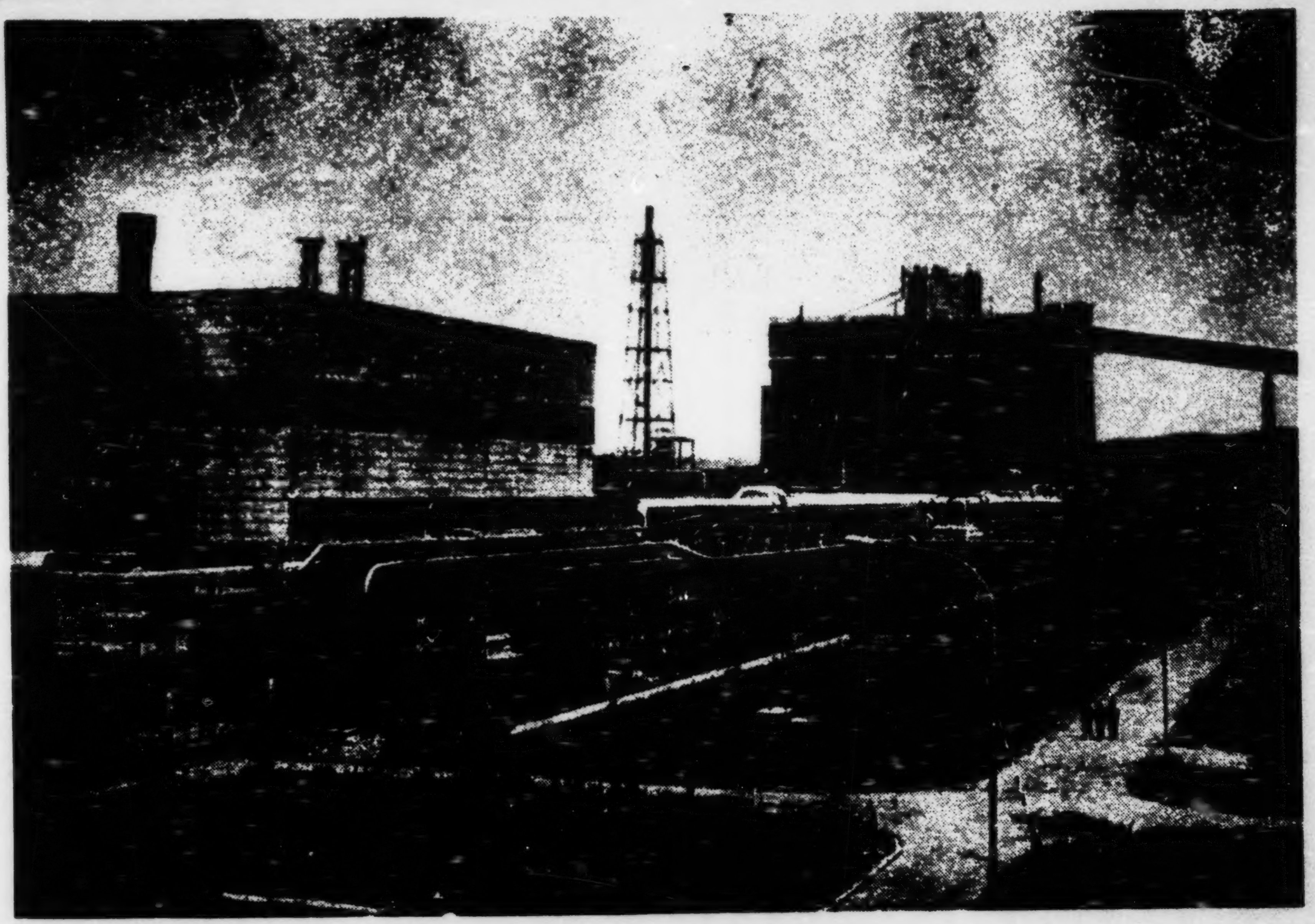


Figure 1

Kosovo Coal Gasification Plant

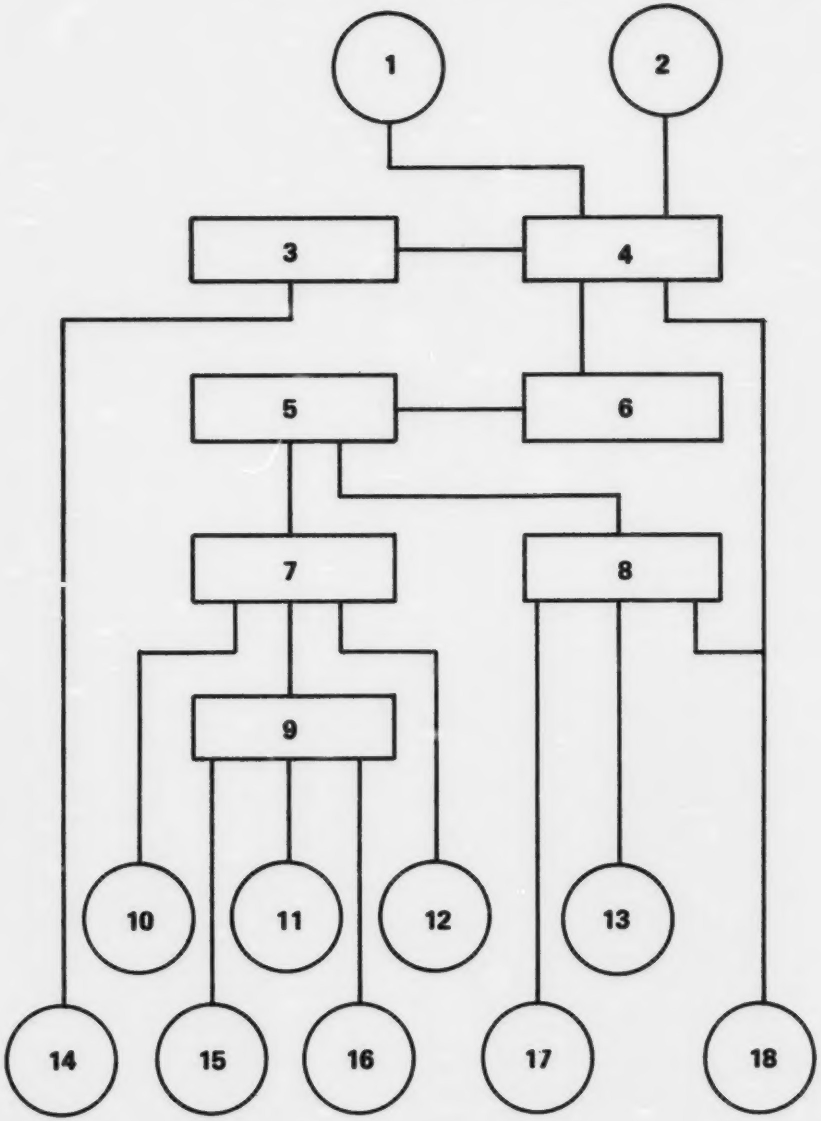
effort and technical discussions including a tentative plan to address both criteria and trace pollutants in the waste stream, under the aegis of the Special Foreign Currency Programs.

Paperwork on this agreement began as far back as July 1974, but there was no real progress until Dr. Gage joined OEMI and he, with staff members Frank Princiotta and Gary Foley, headed an effort resulting in an agreement approved by EPA in January 1976, and by the Yugoslav government in May 1976. The program actually began in July 1976 and is scheduled to run for three years, through 1979. U.S. funding has been set at $290K with a similar amount to be provided by the Yugoslavs.

Dr. Gary Foley (who is now with the Organisation for Economic Co-operation and Development (OECD) in Paris), Kelly Janes and William Rhodes (both of the Industrial Environmental Research Laboratory at Research Triangle Park, NC (IERL/RTP)) made the June 14-22 trip, visiting the several entitites involved in the program--the Rudarski Institute in Belgrade, personnel from the Kosovo Combine (another government owned institute) and the plant itself. The purpose of the visit was to confirm the details of the agreement and to outline a plan for sampling and analysis. Sector Group members had been informed of the impending trip at the Cincinnati meeting, and as will be remembered, were asked for suggestions and comments. One comment regarding the disposal of solid waste, resulted in significant changes in IERL thinking about municipal regulations that might be needed when the industry is commercialized.

The Kosovo plant employs Lurgi technology to produce low-Btu gas. It has six gasifiers, of which only three are currently in operation, and is processing 80 tons of dry lignite per hour. When operating at capacity, it will produce 90,000 Cu.M/H of raw generated gas and 60,000 Cu.M/H of clean gas for remote users. It also produces tar, heavy oil, medium heavy oil, light oil, raw phenol and ammonia water (2.2 T/H, 0.12 T/H, 1.15 T/H, 0.65 T/H, 0.36 T/H and 0.96 T/H, respectively). Figure 2 is a schematic diagram or flow chart which shows the steam and the lignite going through the gasifier and the various related streams. At the time of the visit, only one factory was using Kosovo's gas, but it was also

Figure 2 FLOWCHART OF THE KOSOVO GASIFICATION PLANT



PROCESSING SCHEME

1. PRE-HEATED STEAM
2. DRY LIGNITE
3. AIR DECOMPOSING
4. GAS GENERATORS
5. CONDENSATION
6. COOLING OF RAW GAS
7. TAR SEPARATION
8. GAS TREATMENT
9. PRODUCTION OF PHENOL
10. TAR
11. RAW PHENOL
12. MEDIUM HEAVY OIL
13. PURIFIED LIGNITE GAS
14. PURE NITROGEN
15. AMMONIA WATER
16. HEAVY OIL
17. LIGHT OIL
18. WASTE GAS

being piped to locations in Pristina for home use. Apparently, it is economical for a Communist regime or economy to use low-Btu gas for homes, although it has not proven economically feasible in the United States.

A Yugoslav team from the Rudarski Institute and the Kosovo Combine will visit the United States in October to further review the detailed work plan and to visit some U.S. synfuel installations. Suggestions or comments for discussion during the Yugoslavs' U.S. visit can be directed to Kelly Janes.

EPA-ERDA Interaction

Much of the current interaction between EPA and ERDA can probably be traced to Sector Group activity. The first real interaction was an ERDA tour of some of the in-development, on-going commercial gasification plants. The group visited the Synthane plant in Pittsburgh, the HYGAS plant in Chicago and the Solvent Refined Coal (SRC) Liquefaction Plant in Richland, Washington in January 1976.

EPA's RTP laboratory is currently evaluating data from ERDA's demonstration plants at Fort Lewis, Washington and Homer City, Pennsylvania (Figure 3), as a result of this trip. Mr. McCarthy suggested that as a result of subsequent changes in personnel, it might be useful to arrange another such trip in the near future.

A protocol is now being drafted for joint environmental testing which will initially concentrate on the HYGAS and SRC plants. This effort resulted largely from the cooperative spirit exhibited on the January trip. A final draft of this protocol should be available some time in September. Its implementation will be reported to the AFFSG membership at the next meeting.

In addition, ERDA is now providing EPA with information on ongoing and planned environmental programs in their synthetic fuels pilot plants. EPA/OEMI is reviewing the information which is outlined in Table 1 in order to develop a plan for the general development of synthetic fuel data bases in general.

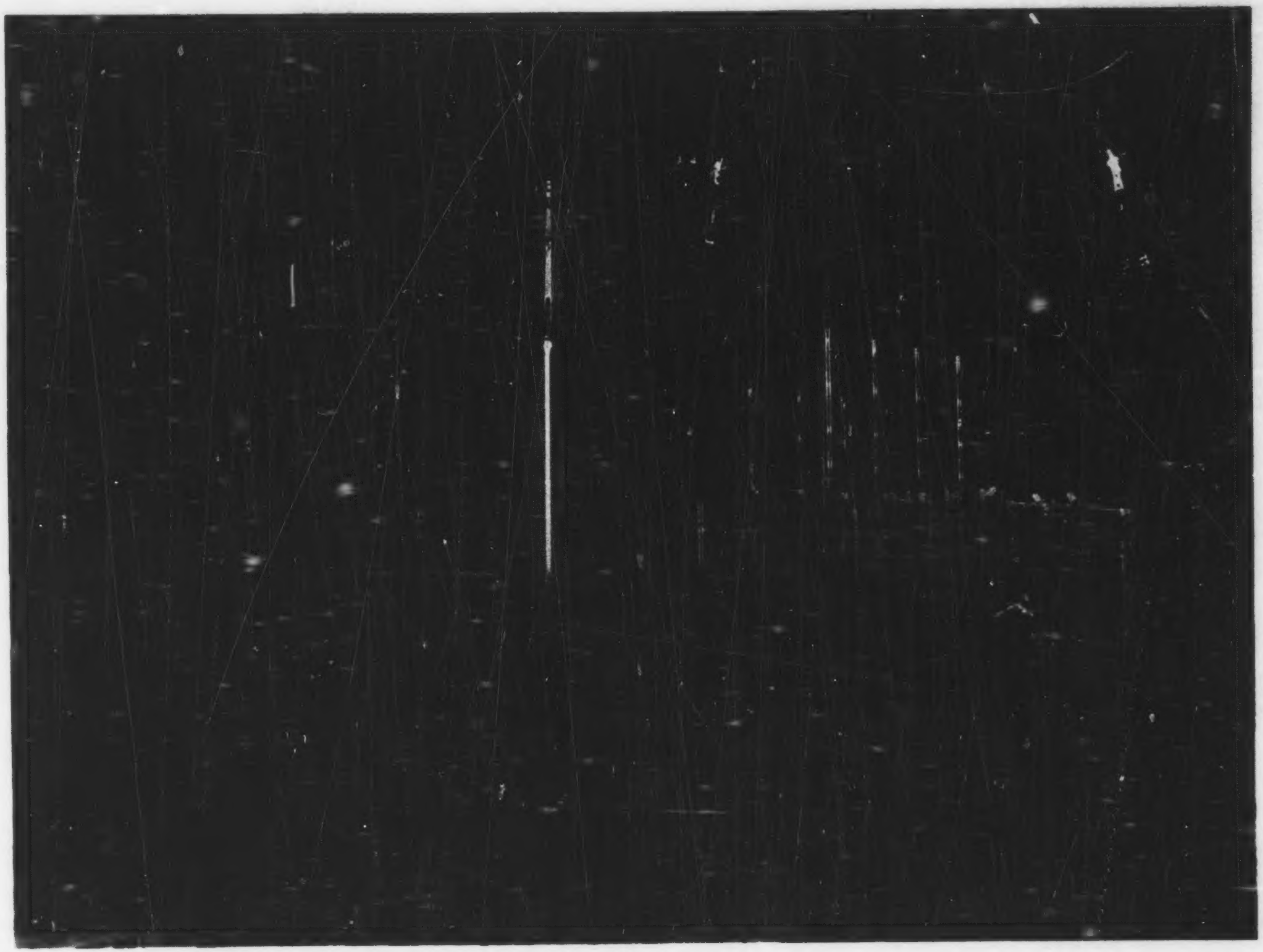


Figure 3

Commercial Coal Preparation Plant Under Construction
by the General Public Utilities Corporation
in Homer City, Pennsylvania

Table 1

ERDA COAL GASIFICATION DEVELOPMENT PLANS CURRENTLY BEING REVIEWED BY EPA

- REVIEW OF GENERAL PLAN FOR STRATEGIC DEVELOPMENT OF AN EFFLUENT DATA BASE
- REVIEW OF SPECIFIC ACTIVITIES

PROCESS AND/OR GROUP	*LOCATION*	*PLAN*
BI-GAS	HOMER CITY, PA	SAMPLING POINT
HYGAS (IGT)	CHICAGO, IL	STATEMENT OF WORK (ENVIRONMENTAL ASSESSMENT)
CO_2-ACCEPTOR (CONOCO COAL)	RAPID CITY, S D	STATEMENT OF WORK (ENVIRONMENTAL ASSESSMENT)
SOLVENT REFINED COAL	FT. LEWIS, WA	PROCESS EVALUATION
CONOCO	NOBLE COUNTY, OH	CONTRACT TERMS WITH REGARD TO THE ENVIRONMENTAL ASPECTS
ILLINOIS CONSORTIUM	PERRY COUNTY, IL	CONTRACT TERMS WITH REGARD TO THE ENVIRONMENTAL ASPECTS

EPA is also providing membership on ERDA task forces for the development and environmental analysis of the Coalcon process.

Coal Gasification Standards Considerations

Preliminary air New Source Performance Standards (NSPS) for sulfur and hydrocarbons are out for review. Comments received relative to these preliminary air standards are of interest and value to both the Standards and R&D groups. One item being reviewed is whether or not these standards should apply to all of the new technologies or only to the Lurgi process. It was noted that the first four plants to become commercial will employ the Lurgi technology. Therefore, a major reason for EPA interest in the Yugoslav plant is that data can be obtained which will indicate some of the problems to be expected in the U.S. commercialization of the Lurgi technology. This will permit inclusion of the environmental considerations in the design rather than requiring the more expensive retrofit. EPA's draft standard will be reviewed with ERDA in September 1976. It has already been reviewed with the National Air Pollution Control Technology Advisory Committee (NAPCTAC) at their August 11, 1976 meeting in Chicago, and possible revisions are now under consideration within EPA. Hopefully, proposed standards can be published on schedule in February of 1977.

There are no plans now for water standards, mainly because it is impossible to know what demands the various air pollution control technologies will impose on plant water use. In spite of this, OEMI is going forward with a multi-media approach to standards in the synfuels area.

Meyers Coal Cleaning Process

EPA is proceeding with the funding for the construction of the Reactor Test Unit (RTU), a small demonstration unit using the TRW/Meyers process.

In terms of coal cleaning resources, through use of the Meyers process, some 90 billion tons of Appalachian coal reserves could be processed to meet New Source Performance Standards. There are cost estimates indicating that it is at least comparable in cost to flue gas desulfurization (FGD) for small installations or for medium-sized utility plants. Commercialization of the Meyers process would also allow increased use of Eastern coal at an overall efficiency of 86 percent without flue gas desulfurization to meet NSPS at a cost of approximately $12/ton, and a 90-95 percent efficiency for pyritic sulfur removal.* Another cost study (EXXON) was slightly higher. This cost also applies to cleaning fine coal. For cleaning coarse coal, TRW estimates half that cost. It was noted that the process does not remove organic sulfur.

EPA has funded $5M for design, construction and a one-year test of an 8-ton/day pilot plant. The construction started in July of 1976 at TRW's Capistrano test site, about 8-10 miles north-northeast of San Clemente. The unit is scheduled to begin operations in March 1977. In the interim, EPA has requested that TRW seek user interest during the one-year test phase. TRW recently submitted a proposal to the Electric Power Research Institute (EPRI) for support of this demonstration.

The Potomac Electric Power Company recently indicated an interest in EPA's Memorandum of Understanding with General Public Utilities (GPU) and New York State Electric and Gas. The discussion indicated that PEPCO had no prior knowledge of the Meyers process. Obviously, an important phase of this project is to make potential users, particularly the electric utilities, aware of the technology that is being advanced. A publication on EPA's Fuel Processing Program which recently became available highlights this process.

The Meyers process basically removes pyritic sulfur, some iron and alkaline ash using an aqueous ferric sulfate solution. Table 2 shows the capital investment involved in the Meyers process. Total operating cost is estimated at $100 per kilowatt of power plant name plate capacity. Figure 4 is a flow diagram of the process. Essentially, the coal is ground, reacted, washed to remove the sulfur and then the leach solution is regenerated. The first reaction removes 80 percent of the pyritic sulfur, and a subsequent reaction raises the removal to 90-95 percent. Figure 5 is an artist's conception of the RTU (including the holding pond) and the housing facility, where the analysis will be done.

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* EPA estimate

Table 2

CAPITAL INVESTMENT
(MEYERS PROCESS)

ITEM	PERCENT OF TOTAL	
REACTION	25	
WASHING	9	
SULFATE REMOVAL	12	
SULFUR REMOVAL	7	
PROCESS TOTAL		53
OFF SITE		27
CONTINGENCY		20

Figure 4

TRW Process Flow Diagram for Fine Coal Processing
(Meyers Process)

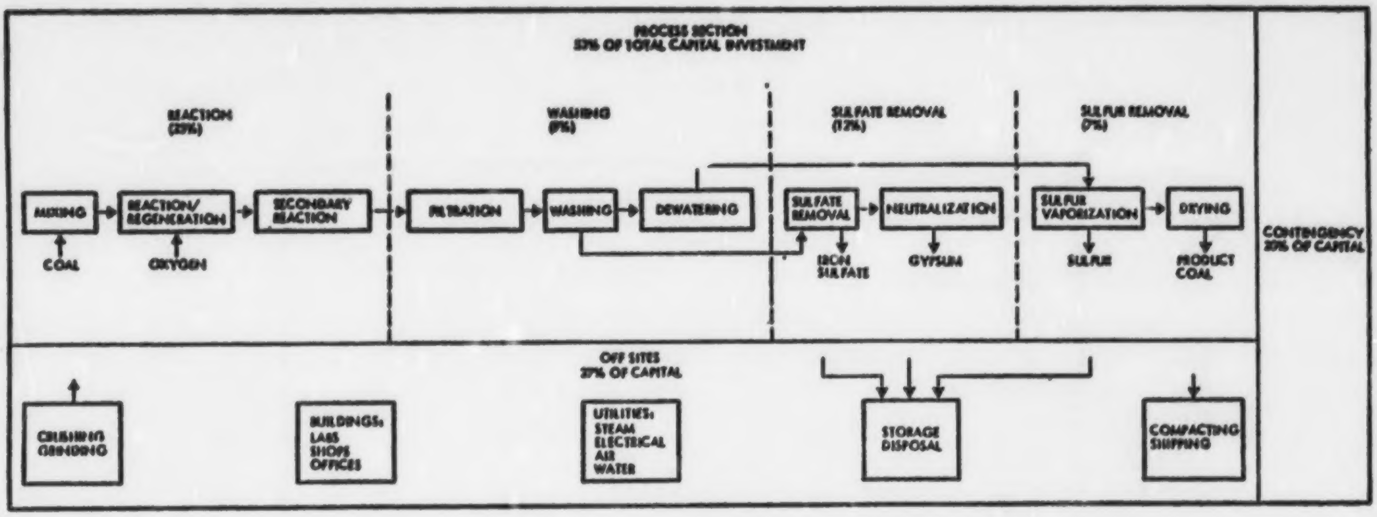
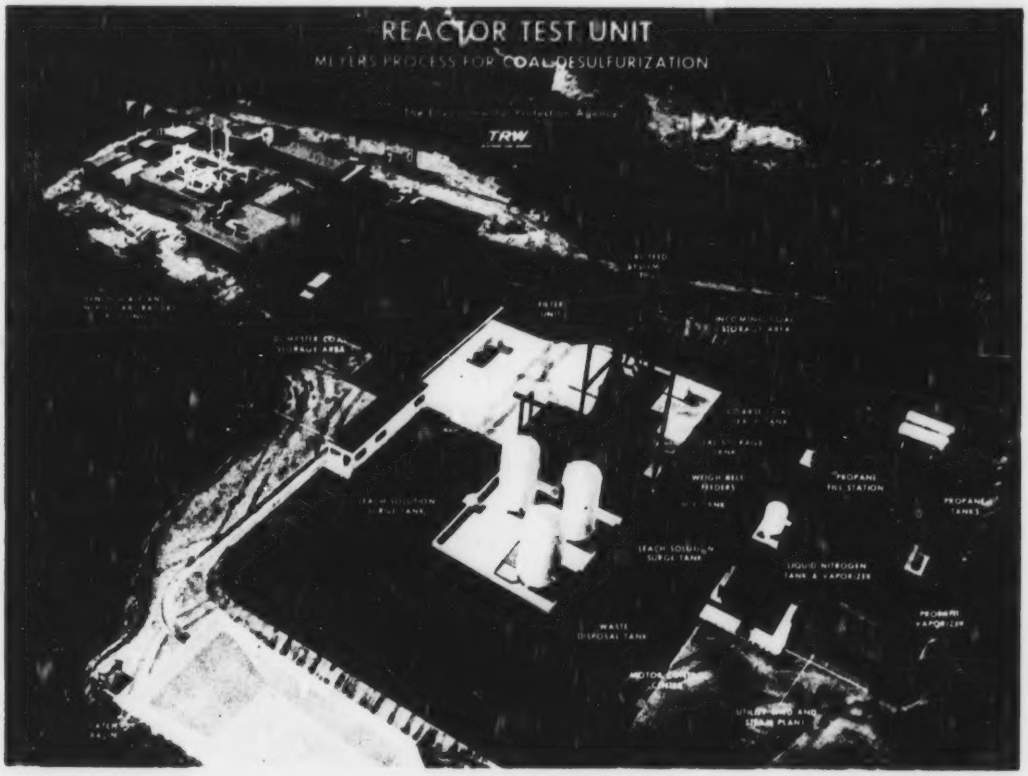

PROCESS SECTION
53% OF TOTAL CAPITAL INVESTMENT
REACTION
(25%)
WASHING
(9%)
SULFATE REMOVAL
(12%)
SULFUR REMOVAL
(7%)
MIXING
REACTION/ REGENERATION
SECONDARY REACTION
FILTRATION
WASHING
DEWATERING
SULFATE REMOVAL
NEUTRALIZATION
SULFUR VAPORIZATION
DRYING
COAL
OXYGEN
IRON SULFATE
GYPSUM
SULFUR
PRODUCT COAL
CONTINGENCY
20% OF CAPITAL
OFF SITES
27% OF CAPITAL
CRUSHING GRINDING
BUILDINGS:
LABS
SHOPS
OFFICES
UTILITIES:
STEAM
ELECTRICAL
AIR
WATER
STORAGE DISPOSAL
COMPACTING SHIPPING

Figure 5


REACTOR TEST UNIT
MEYERS PROCESS FOR COAL DESULFURIZATION
The Environmental Protection Agency
TRW
FILTER UNIT
INCOMING COAL STORAGE AREA
STORAGE AREA
COARSE COAL
WEIGH BELT FEEDERS
PROPANE FILL STATION
PROPANE TANKS
LEACH SOLUTION SURGE TANK
LEACH SOLUTION SURGE TANK
LIQUID NITROGEN TANK & VAPORIZER
PROPANE VAPORIZER
WASTE DISPOSAL TANK
MOTOR CONTROL CENTER
UTILITY AND STEAM PLANT

Economically, the Meyers process may be combined with physical coal cleaning as a means of reducing the capital costs of the plant. Physical coal cleaning removes only 25 percent of the sulfur which for some coals may meet the New Source Performance Standards. Therefore, some computer modeling is planned to determine the best mix, considering the economics, between physical and chemical coal cleaning. Meeting NSPS most inexpensively and avoiding customer rate increases is the prime objective of potential utility users.

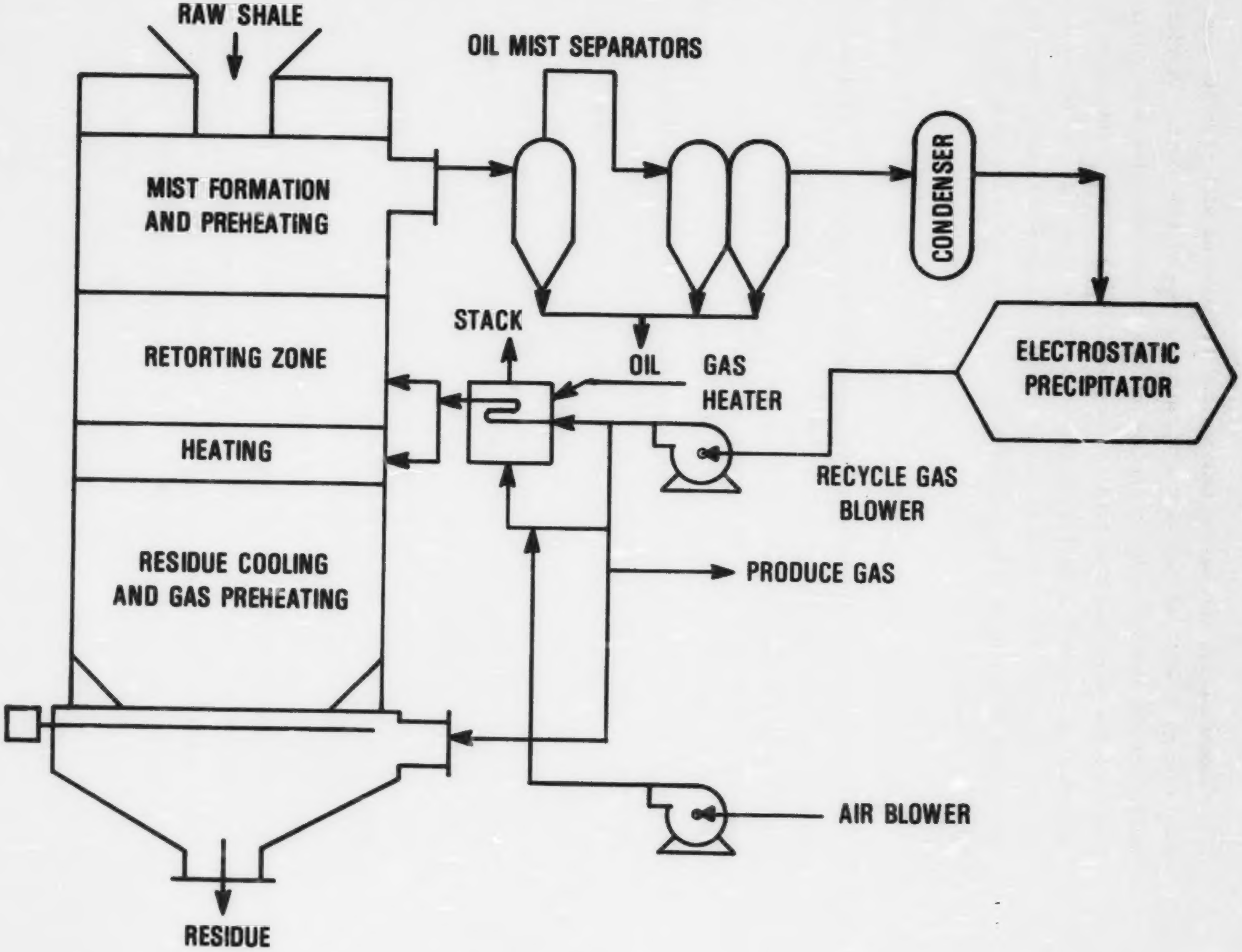
Oil Shale Program

A preliminary assessment of the sampling and analysis for the oil shale program is being carried out at the Paraho facility by TRW and Denver Research Institute (DRI) in cooperation with Paraho Oil Shale Demonstration, Inc., and ERDA's Laramie Energy Research Center (LERC). EPA's Environmental Assessment Program's purpose is to provide a starting point in defining sampling points, sampling methodology, analytical methods and an interpretation of operating parameters. Some tests of the retort have been completed and the results should be available soon. It must be realized, however, that data were collected under atypical conditions. Figure 6 is a flow chart of the retort. (See Alden Christianson's presentation, page 64.) The overall oil shale program represents a cooperative effort between ERDA and industry.

As a result of the discussion at the last Sector Group meeting, it became apparent that there was a great deal of information on efforts of oil shale development, environmental factors, etc., of which individual Sector Group members were collectively aware. Therefore, Stanford Research Institute (SRI) was asked to make a preliminary survey of the information available and compile a bibliography for Secter Group use. Draft copies of the bibliography were then made available to the group. The members were asked to review it and add any publications, reports or other information available of which they were aware but that had not been included.

Figure 6

PARAHO RETORT - INDIRECT MODE


RAW SHALE
OIL MIST SEPARATORS
MIST FORMATION AND PREHEATING
CONDENSER
STACK
RETORTING ZONE
OIL
GAS HEATER
ELECTROSTATIC PRECIPITATOR
HEATING
RECYCLE GAS BLOWER
RESIDUE COOLING AND GAS PREHEATING
PRODUCE GAS
AIR BLOWER
RESIDUE

In addition, a Smithsonian Science Information Exchange (SSIE) computer listing of various ongoing government funded efforts in the oil shale area which had been obtained was distributed to the Sector Group.

Modifications to the Environmental Problems Research and Development Program Document (Blue Book)

An update of the Blue Book had been mailed to Sector Group members several weeks before the meeting. The Blue Book is the working handbook of the OEMI and interagency Advanced Fossil Fuels programs, including allocation of funds and an outline of problems. The update was necessitated by program milestone setbacks resulting from delays in legislation, funding revisions and changes in ORD strategy with respect to advanced fossil fuels processing.

As a result of discussions at the Executive Committee and Sector Group meetings in March, it was determined to include related program areas within EPA--air quality, water quality, policy implications and integrated assessment--that are affected by OEMI's R&D efforts. Drafts of this material have been completed and will be made available to the Sector Group at or before the January 1977 meeting.

A questionnaire was distributed with the Blue Book update as a means of ensuring that the Blue Book contents are as practical as possible. Members were asked to critique the book, its emphasis, structure, and contents for optimum usefulness. If the Blue Book does not meet the need for which it has been intended, the funds will be diverted to other uses.

Discussion

Two points brought out in the discussion following Mr. McCarthy's presentation were:

- EPA is partially supporting the Fourth National Conference on Energy and the Environment, October 4-7 in Cincinnati. There will be a morning session and an afternoon session devoted primarily to the EPA Interagency Coal Cleaning Program on October 6. The morning session will discuss the resource aspects and the afternoon session, cleaning processes.

- TRW has a contract with EPA (to date close to $5 million) to design and construct a coal cleaning plant and perform a one-year test program to determine the economic feasibility and effectiveness of the Meyers' process. The project will be monitored by EPA's Industrial Environmental Research Laboratory in Research Triangle Park, NC.

SESSION II: EPA/ORD ADVANCED FOSSIL FUELS RESEARCH AND DEVELOPMENT PROGRAMS

The second session, chaired by Dr. Foley, was an overview of the various advanced fossil fuels research and development programs that are ongoing in EPA's laboratories. He urged member participation in the discussion periods following the presentations.

A. Advanced Oil Processing--The Chemically Active Fluid Bed (CAFB) --Mr. Sam Rakes

Dr. Foley then introduced **Mr. Sam Rakes**, Project Officer with the Advanced Processes Branch of the Energy Assessment and Control Division at EPA's Industrial Environmental Research Laboratory in Research Triangle Park, who discussed Advanced Oil Processing, specifically, the Chemically Active Fluid Bed (CAFB) technology.

Background

Mr. Rakes explained that CAFB refers to a process that was initiated by the ESSO Research Center in England about 1966. The entire research and development effort was an in-house project of the ESSO Petroleum Corporation until 1970. (ESSO has now become EXXON except in the United Kingdom where they have retained the original name.) It became evident that the process showed promise in late 1969 and 1970, but since further development offered no particular advantage for a petroleum company, EPA's predecessor undertook a joint project with the ESSO Research Center at Abingdon, England, based on a contract signed in June 1970. Since then, work has progressed on a cooperative basis with both ESSO (EXXON) and EPA providing funding. The work has now been underway for about 10 years; six with EPA sponsorship. Mr. Rakes pointed out two significant differences between this and the usual EPA R&D program:

- It is now going into a development phase; and

- The utility is not involved directly with EPA, but rather with an EPA contractor, resulting in a unique relationship, in that EPA does not have direct arrangements with the host utility, at the request of the utility.

Objectives and Rationale

This advanced oil processing is based on the development of chemically active fluid bed (CAFB) technology, involving the production of low-sulfur gas from high-sulfur residual oil. The process works with oil of high metal content, presents a relatively low solid waste problem and offers a retrofit control mechanism for existing gas- or oil-fired boilers requiring conversion to high-sulfur fuels.

This is of importance because there is a large inventory of gas-fired boilers throughout the southwest that are not readily convertible to any other fuel. For example, in Texas, natural gas will probably not be available for many more years, while the boilers already installed have a remaining useful life of about 20 to 30 years.

Environmental Objectives

Environmental objectives include development of a means of comparing process costs and capabilities with conventional flue gas desulfurization technology, determination of emissions and the environmental impact of the process, evaluation of appropriate waste disposal methods and a comparative evaluation based on an environmental assessment of alternative technologies.

Program Description

Mr. Rakes explained that the demonstration plant for gasification/cleanup of high-sulfur residual oil in lime or limestone fluidized bed is the La Palma station of Central Power and Light (CPL), located in San Benito, Texas. CPL is one of four subsidiary utilities of the Central and Southwestern Corporation, which has its home offices in Corpus Christi, Texas.

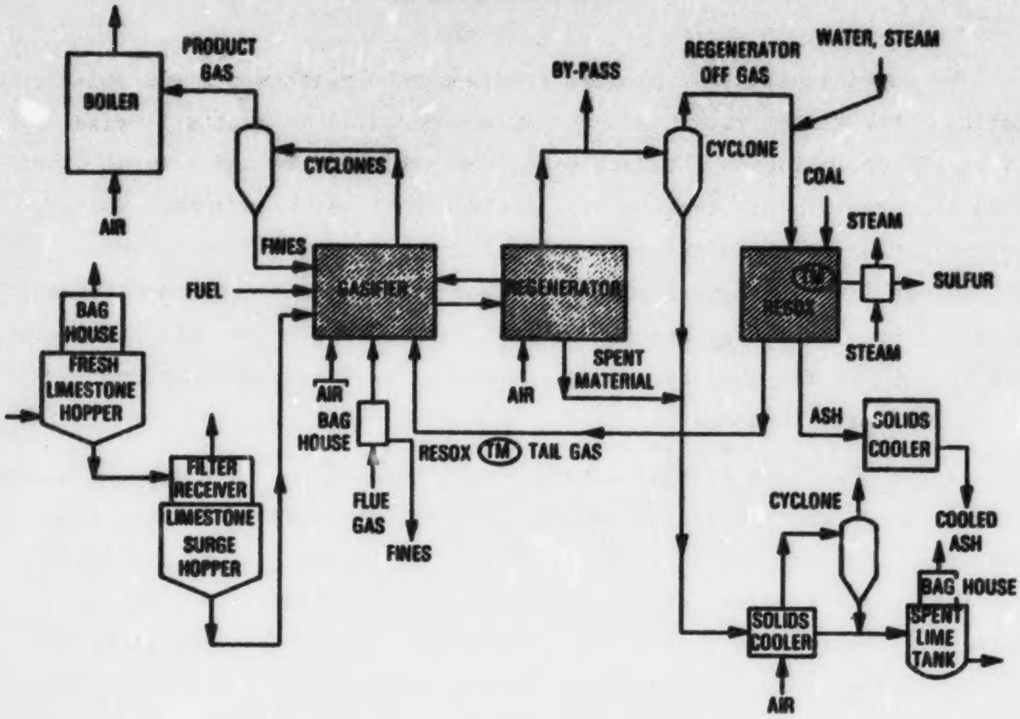
The experimental test program involves both performance and emission testing. The demonstration project is a nominal 10 megawatts in size ("Nominal" depending on the fuel used, the air velocity and several other factors). Performance testing will include that which is normal for any new utility boiler. Emissions testing will be related to New Source Performance Standards where applicable but will include other environmental testing. Some emissions testing will be carried out by the EPA contractor, some sub-contracted and, for certain specific analyses, independent contractors will be used.

Figure 7 is a non-quantitative schematic of the CAFB process as it was planned for the demonstration. Mr. Rakes stated there have been some minor changes, but this is basically the process. It is significant that the sulfur recovery step is proprietary (Foster-Wheeler's Resox process). The rest is fairly straightforward, noting that the gasifier and regenerator shown here as two separate vessels, are actually in one vessel, separated by a dividing wall.

Figure 8 is a conceptual drawing of the main vessel planned for the Texas demonstration project. It is based on standard boiler design technology with the exception of the fluidized bed. The vessel, a refractory lined steel box with a dividing wall, is square because the pressure is essentially atmospheric, although there is some differential pressure (on the order of a few inches of water forge) inside to move things around.

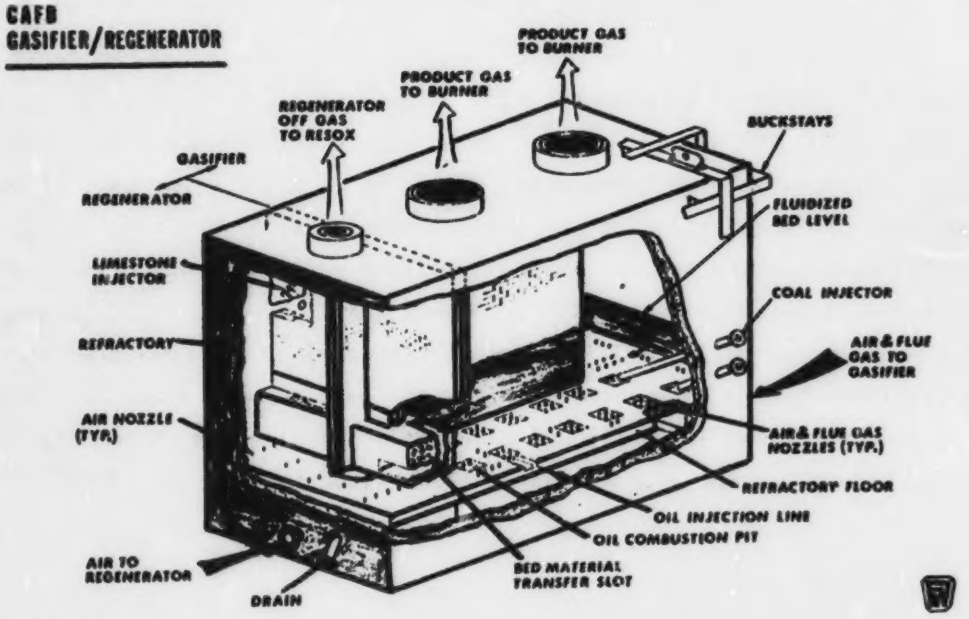
Mr. Rakes indicated that in evaluating the economics of the CAFB process as a control alternative to flue gas desulfurization (FGD), paper studies have been carried out, but obviously cannot be considered definitive. Hopefully the La Palma station will be on a scale adequate to provide reasonable certainty of the economics and cost of the process. Paper studies were carried out for the ESSO England pilot unit which is rated a nominal 0.75 megawatt. Actually, it has a rating of about 2900 kilowatts gross thermal output, the 0.75 megawatt representing the projected electrical equivalent if a conventional boiler and turbine were used, thus there is a size factor of 10-20 for the La Palma unit. The actual thermal output of the CAFB unit is in excess of 2900 kilowatts. It over fires a 10

Figure 7
CAFB SCHEMATIC



PRODUCT GAS
BOILER
AIR
CYCLONES
FINES
FUEL
GASIFIER
BAG HOUSE
FRESH LIMESTONE HOPPER
FILTER RECEIVER
LIMESTONE SURGE HOPPER
AIR
BAG HOUSE
FLUE GAS
FINES
RESOX (TM) TAIL GAS
BY-PASS
REGENERATOR
AIR
SPENT MATERIAL
REGENERATOR OFF GAS
WATER, STEAM
CYCLONE
COAL
RESOX (TM)
STEAM
SULFUR
STEAM
ASH
SOLIDS COOLER
COOLED ASH
CYCLONE
BAG HOUSE
SPENT LIME TANK
SOLIDS COOLER
AIR

Figure 8



CAFB GASIFIER/REGENERATOR
PRODUCT GAS TO BURNER
PRODUCT GAS TO BURNER
REGENERATOR OFF GAS TO RESOX
GASIFIER
REGENERATOR
BUCKSTAYS
FLUIDIZED BED LEVEL
LIMESTONE INJECTOR
COAL INJECTOR
REFRACTORY
AIR & FLUE GAS TO GASIFIER
AIR NOZZLE (TYP.)
AIR & FLUE GAS NOZZLES (TYP.)
REFRACTORY FLOOR
OIL INJECTION LINE
OIL COMBUSTION PIT
AIR TO REGENERATOR
BED MATERIAL TRANSFER SLOT
DRAIN

million Btu/hour boiler, and thus turns out to be more efficient than was expected. The pilot unit cannot be extended to its full potential since the boiler is not large enough to take the full output of the bed as it was constructed.

Aside from the contract with ESSO England, EPA has had contracts with Westinghouse Research Labs since 1969 for engineering support studies, and also has a contract with Foster-Wheeler Energy for the present demonstration project.

Mr. Rakes stated the Foster-Wheeler effort addresses handling of spent sorbent. Limestone was chosen because of its availability and usability. The selection process is at the point of determining which limestone available to the site is best ("best" being defined as the cheapest limestone delivered at the site that is usable in the process). Most of the limestone tested has proven usable.

ESSO England began work on spent sorbent processing, utilization and disposal, about a year and a half ago. They took some of their spent sorbent, heat treated it, ran some controls, put thermocouples in it, left it outside for a year and carried out monitoring and chemical analysis to trace what happened.

There are a number of options for disposing of spent sorbent since it is a dry product. It could be returned to the quarry from which the raw stone was mined and used for fill. Various other approaches, alternatives and options are being investigated.

As indicated, a sulfur recovery program (Foster-Wheeler's proprietary Resox process) will be used for the Texas demonstration. Other sulfur recovery steps are being examined to determine if a better process now exists or is being developed.

Right now the plan is to take the gas produced, burn it in a normal boiler and produce electricity. One of the alternate concepts being considered is combined cycle. Paper studies are being conducted to determine other possible uses of the process.

Limitations and Constraints

Earlier it was indicated that there is a large inventory of gas-fired units, in this case 120,000 megawatts, which cannot burn heavy oil or coal directly. Although some gas-fired plants were designed so as to be able to burn alternate fuel (solids as well as residuals), many were not. However, even some of those that were designed to burn alternative fuels are proving unable to do so. In at least one case, even the firing of number 2 oil presented a problem, let alone number 6 or heavier oils such as some of the other residuals. Some of the residual oils used in CAFB are solids at room temperature.

Economic and environmental factors, when developed, need to be compared with those of possible alternative technologies such as demetallization, hydrosulfurization (which will be discussed later), partial oxidation with low-temperature cleanup and flue gas cleaning.

Program Status

The San Benito Demonstration Plant conversion design is more than 90 percent complete, indicated Mr. Rakes. Excavations have begun for additional footings. Data of fuels and limestone are being obtained from the ESSO pilot facility. Number 6 oil and heavier oils are being considered for use, including some fuels that the refineries usually cut back with distillate to number 6. If such oils can be used directly without cutting, more distillate will be available to refineries and for heating or diesel fuels. Solid fuels, including some coals and lignites, are also being considered.

Westinghouse is providing specialized engineering manpower and expertise (unavailable in EPA and impractical to obtain on short notice) in such areas as sorbent selection, sulfur recovery schemes and other alternate concepts.

Environmental assessment has been planned for all phases and has been initiated. All three basic contracts connected with the demonstration include environmental assessment tasks and two contracts have been approved which are entirely associated with environmental assessment. One of the later has been awarded, the other is in the negotiating stage.

Problems and Issues

Retrofit difficulties associated with modification of existing generating plants were a very real problem in setting up the San Benito project. The plant itself is old, and a large number of local pipelines are no longer in use. The exact location of many of those in use was not known. Three sets of drawings by two different contractors were found which did not match.

The problem was overcome by:

1) Flying aerial survey with bench marks and scales painted on the ground. Often, even if a pipeline has been buried 20-30 years and no evidence of it remains from an on the ground view, an aerial photo will reveal its trace.

2) Constructing a 3/8" to 1' scale model, permitting routing ducts and piping through existing piping.

The plant also posed one particular environmental problem--an avocado tree that could be trimmed back, but not removed. The main compressor housing site was initially planned for that spot. As was mentioned earlier in discussing the ESSO England pilot facility, the burner design was fine, except that when it was scaled up, it proved to be too large for the existing boiler and necessitated redesign of the burner. Those are a few of the retrofit difficulties that may occur and should be considered when introducing new technology into an old plant. They are, however, not insurmountable.

Another possible problem is that the CAFB process removes any trace metals from the fuel to the spent stone which may lead to disposal problems—virtually 100 percent of the vandium was retained in the fluid bed along with a high retention rate of nickel, sodium, some of the alkali metals, and various other trace metals. These were present as impurities in the initial limestone or were sequestered from the oil during gasification processing.

Mr. Rakes stated that sensible approaches are needed to handle such process characteristics as coke deposits, stone dust carry-over, solids handling, and high volume/high temperature gas ducting/combustion. Again, these are not insurmountable problems. In fact, workable solutions have been found for most of them. The process is now at the point where only a relatively large scale demonstration such as that planned in the San Benito will determine whether or not the results of the paper studies and the bench scale model studies at ESSO England are adequate in terms of accuracy of results and capability to predict results of further development.

One problem avoided by the CAFB process is the need for cooling and scrubbing to remove sulfur in partial oxidation processes (which loses sensible heat and lowers efficiency). The CAFB process does not cool the gas once it is generated and there is no scrubbing step, so CAFB offers potential advantages in efficiency, environmental impact, and in capital equipment costs. The San Benito demonstration plant is expected to provide confirmation of this.

CAFB may also be a viable control approach if trace metal standards lower the amount of usable residual oil. For example, if a standard is set on the emission of trace metals into the air thus restricting the use of oils with greater than a certain percentage of trace metals, CAFB is a process where the problem is solved at the same time the fuel is burned. It must be emphasized, however, that CAFB is strictly a produce onsite, use onsite, proposition at this time.

Options for Future Work

There are numerous options for future work. One (including solid fuels), is in progress as part of a letter contract with ESSO England. Some good results have been obtained with solid fuels, both under EPA sponsorship and inhouse at ESSO and Foster-Wheeler. Both ESSO and Foster-Wheeler have agreed to make their work and its results available to EPA.

Alternate stone disposal/utilization options for the demonstration are being considered. They offer many possibilities, and there is some indication that EPA may have a saleable product in this area by the end of 1977.

After determining the capabilities of the CAFB process and the standards of practice or control technology, recommendations for supporting standards development will be framed, either for CAFB, or, if one becomes available, for a better technology. Long-term environmental monitoring--3-5 years as opposed to the current 1½ year program--is indicated.

The development and demonstration of promising process and optimum control and disposal systems, modifications, fine tuning and refining processes to achieve their utmost potential, is another area for future work.

Technology transfer to potential users is a never ending future work load. Currently, more than one paper on the CAFB process is presented each month to various societies (i.e., the American Society of Mechanical Engineers (ASME), the American Institute of Chemical Engineers (AIChE)) and to groups such as this Advanced Fossil Fuels Sector Group (AFFSG). This is an extremely important part of the Advanced Processes Branch's job, to ensure that users know the process, its limitations and particularly its potential.

Interaction with Other Programs

Information on CAFB and samples of the fuels proposed for use, are being provided to other EPA programs and to several contractors for their information and evaluation.

Mr. Rakes indicated a strong data base on the CAFB process is being developed so that should a standard be challenged, there will be a strong base from which to defend it. IERL itself is not in the standards setting business, but is required to provide a data base for EPA program offices to use in setting and successfully defending a standard.

IERL has been providing monthly reports to ERDA since the start of the contract with Foster-Wheeler. ERDA's cold model facility was used at Foster-Wheeler to do some solids transfer work. The facility is scheduled to be dismantled in mid-October and sent to the Morgantown Energy Research Center.

As part of the contract between Foster-Wheeler and CPL, access, samples and required information are to be provided as requested by EPA. This project is, therefore, a good example of interaction with industry. It is jointly funded by ESSO, Foster-Wheeler, the utility and EPA. Foster-Wheeler's main contribution is that they are doing this project on a cost reimbursable contract with no fee. Central Power and Light is contributing something in excess of $3 million to this project, as well as absorbing various other costs associated with provision of two full-time participants on the Steering Committee, supplying engineering drawings, operators, operating the plant, etc. The exact amount of this contribution cannot be determined but it is obviously significant.

Discussion

The discussion following the presentation involved several areas of concern:

- The utilization of used crankcase oil--While Mr. Rakes indicated that crankcase oil has not been tried in the process, he could see no reason that it could not be, since it is more volatile than the residual number 6 oil which has been tried. The ESSO group in England has addressed that question and came to the conclusion that crankcase oil could be fed and gasified and no research to date has indicated otherwise. To verify that it is usable under present circumstances may present a problem, since it would be necessary to ship the crankcase oil to England and/or collect appropriate samples over there. Since the process is efficient in relation to the handling of trace metals, it was pointed out that it should be close to ideal as a means of utilizing used crankcase oil.

- The Btu content of the gas produced--It was stated that the Btu content varies widely within the low-Btu range, but in round numbers was of the order to 200 to 250 Btus. It was further indicated that the output gas is at about 1600 degrees and thus about 25 percent of its value is in sensible heat.

- Resox status--It was indicated that there had been problems with plugging, which appear to have been resolved. Concern was expressed as to how well the process would work despite assurances from Foster-Wheeler. It was agreed that the situation would be followed closely through monthly reports and that presentations on the subject which had previously been planned for the Electric Power Research Institute (EPRI) would be carried out.

- Economic viability of CAFB--It was stated that not much had been said about the economic aspects because of the rather rapidly varying economic situation as regards energy costs and availability as well as the variation associated with the costs of retrofitting which depends to a great extent upon the type and condition of each plant under consideration. As of the last evaluation, it appeared that costs were competitive with flue gas desulfurization techniques.

- CAFB Specimens--Dr. Coffin said that he had gained new information in that he had not been aware that specimens (samples) had been sent to him (or to his laboratory). Apparently, Foster-Wheeler was to have sent them directly and it was agreed that the situation would be checked out.

- Elaboration on the environmental monitoring program associated with CAFB development--This discussion involved program intent, type of activity and definition of terms. In general, it was stated that the main objective is that of determining systems impurity, removal effectiveness at or shortly after start-up as a means of determining comparative effectiveness after years of operation. It was pointed out that such an effort appeared to be more associated with waste treatment characterization than field monitoring to which Mr. Rakes responded that there was to be some field monitoring even though such an effort was not necessarily within their charter and that the extent of the activity would depend on the interest and support available from other (EPA) laboratories. It was indicated that the output product (low-Btu gas) would be monitored as well as the waste streams and that product monitoring is considered part of performance testing.

B. Advanced Oil Processing (Desulfurization/Demetallization/Denitrification)--Mr. William Rhodes

Next, Dr. Foley introduced Mr. Bill Rhodes, Program Manager, Synthetic Fuels, OEMI/IERL-RTP. Mr. Rhodes presented a brief summary of work on advanced oil treatment (other than the CAFB process) that is in progress at EPA's IERL-RTP.

Objectives and Rationale

Mr. Rhodes began by stating that the objectives of the work are the development of methods of removing heavy metals, sulfur, nitrogen and other contaminants from the liquid fuels prior to their combustion.

The rationale for this work is that based on past history, the pretreatment of liquid fuels is expected to be less expensive than treatment after combustion, since waste gas control techniques have not been easy or cost effective for smaller area source users (future developments may change the picture, but at present waste gas control techniques become increasingly expensive as they are scaled down); technology development would be beneficial to the oil refinery operations, both from a cost viewpoint and also from expanding the types (grades) of oils that they would be able to treat; and the technology should be applicable to synthetic fuel liquids. The last of these items is under consideration during the initial work.

Environmental Objectives

The environmental objectives include the development of environmentally sound advanced oil treatment techniques that would potentially reduce emissions of harmful health and ecological contaminants in fuels.

Program Description

The program at this point consists of the development of improved scavengers for heavy metal contaminants in residual fuels; i.e., fuels with 600 or more parts per million of vanadium and nickel, and perhaps three and one-half percent or more of sulfur. It also includes research on techniques for removing nitrogen from fuels and determining the relationship to nitrogen removal or researched techniques for removing metals from liquid fuels.

Constraints and Limitations

There are very limited financial and manpower resources in this area. In addition, most industrial R&D is proprietary, particularly in the area of catalyst development, which poses a problem since the latest catalysts which are under development are not usually available for purposes of evaluation.

Program Status

In heavy oil demetallization, EPA has ongoing bench scale evaluations, primarily at Hydrocarbon Research, Inc., in Trenton, N.J. Hydrocarbon Research has been looking at a one percent molybdenum on an activated bauxite as the scavenger for use prior to conventional hydrodesulfurization.

EPA also has a cooperative pretreatment program with the Soviet Union. At present, a joint report is being written on the results of this work. EPA has conducted tests with Soviet catalysts on some U.S. oils, as well as tests with U.S catalysts on Soviet oils, and the Soviets performed similar tests.

In the denitrogenation area, EPA has a research grant with the Massachusetts Institute of Technology (MIT) to study the hydrodenitrogenation (HDN) and hydrodesulfurization (HDS) kinetics and reaction mechanisms on generic compounds (sulfur and nitrogen). The work is expanding slowly to include operation at pressure and additional multi-ring type sulfur and nitrogen compounds.

Hydrocarbon Research is reviewing and evaluating catalyst characteristics for optimum denitrification as an offshoot of the work they did for EPA on sulfur and trace metal removal.

EPA has also performed a survey of the chemistry involved for alternate methods of sulfur, nitrogen, and other contaminant removal to determine whether there are other approaches, not currently under consideration, which could be viable.

Problems and Issues

Mr. Rhodes pointed out that the sulfur, nitrogen and metal contents of synthetic liquid fuels are either unknown or unpublished. Quantification of nitrogen oxide contribution by the nitrogen contained in the fuel, and the degree of control by combustion control techniques, are still in the development stage, so their effectiveness is unknown and the possible contributions of fuel pretreatment in this area are uncertain. Simultaneous removal of nitrogen and sulfur seems to be a desirable direction whether or not simultaneous removal is feasible. There is limited information on disposal and utilization of recovered heavy metal residuals from the processing of heavy oil and coal based feedstocks.

Some of the issues under consideration are: 1) should great emphasis be placed on studies of contaminant removal from synthetic liquid fuels? and 2) what is the degree and type of utilization of processed synthetic fuel liquids? (Perhaps synthetic fuels could be directed to particular market areas depending on the process to be utilized and other relevant factors. Depending on the market, different standards might be met based on variations in precombustion control.)

Options for Future Work

Options for future work include: 1) continuation of demetallization evaluations at bench scale level, 2) design of a pilot or demonstration facility as an add-on to an existing HDS unit based on existing bench scale data, 3) performance of additional R&D on other possibly viable approaches, and 4) the recovery and utilization of process contaminants such as vanadium and nickel, that are deposited on the scavengers.

Interactions with Other Programs

Other EPA programs that should eventually be interacting with those in advanced oil processing include those associated with health and ecological effects, transport processes and characterization and monitoring. Due to the early stage of the research, there has not been much basis for interaction as yet.

Outside EPA, OSHA-NIOSH would obviously be involved in sampling and evaluation within a plant as work progresses.

Certainly industry, looking toward possible utilization of their expertise in the pretreatment area and toward joint development problems where feasible, should be involved.

Discussion

Matthew Reilly, ERDA; Stephen Brown, SRI; Gary Foley, EPA; and Gerald Rausa, EPA, were actively involved in the discussion following Mr. Rhodes' presentation which provided the following additional information on the advanced oil processing programs:

Level of Funding: The level of funding for all the programs mentioned is about $200,000 a year.

Screening of Catalysts: Initially, various metals and scavengers were screened to arrive at the approach currently being evaluated--a one percent molybdenum on an activated bauxite. Some preliminary testing has been done to optimize the level of contaminant removal in pretreatment so as to minimize the combined cost of the total desulfurization process (to include costs of later stage hydrodesulfurization).

Application to Synfuels: The scavenger technology is being considered for possible application to synthetic liquids, basically for hydronitrogenation since the oil shale or coal liquids used may contain about two percent nitrogen. The plan involves evaluation of various catalyst characteristics to determine optimum pore size distribution, metal loadings, etc., to arrive at a more optimum HDN scavenger. This is seen as a rather firm requirement because of the direction the current coal liquefaction development process appears to be taking.

The possible need for or advantage to pretreatment earlier in the process stream is being considered. However, the objective is not to develop a process for obtaining coal liquids but to make such fuels, if developed, more environmentally sound.

Costs of Application: This technology could be considered an alternative or complement to combustion modification. Until firm standards for the nitrogen content of coal liquids and shale oil are set, the effectiveness of the combustion modification technology under development cannot be evaluated. If a significant amount of the fuel nitrogen can be removed, the combustion modification job may be that much easier.

Economics is always an issue and economic competitiveness is an objective for this technology. The process is not yet far enough along to project the economics based on HDN, other than in a gross sense, but it certainly appears that it will be less than the $4/barrel for shale oil denitrification mentioned by an industrial representative at the March 1976 Sector Group meeting.

Availability of Pertinent Data: Data on nitrogen, sulfur and metals in shale oil and coal oils is now becoming available. Carl Beers at Oak Ridge National Laboratory has several publications on the subject. Detailed data, especially in relation to the processes and the different conditions under which they may eventually be run, is still lacking.

C. Oil Shale--Mr. Alden Christianson

Mr. Alden Christianson, Director of the Energy Systems Environmental Control Division at EPA's Industrial Environmental Research Laboratory in Cincinnati, Ohio was introduced by Dr. Foley to discuss EPA's oil shale program.

Introduction

EPA is supporting work in several R&D categories that relate, either directly or indirectly, to oil shale--environmental assessment, control technology development, pollutant transport, ecological effects, health effects and measurement and monitoring. These all apply in some way to oil shale development and some are specifically related to oil shale.

There is a great deal of interest in this non-existent industry. Much emphasis was placed on oil shale--problems, issues and activities--at the last Sector Group meeting. This information was documented in the Sector Group meeting report. The Energy Systems Environmental Control Division of IERL-CINC is involved primarily in the area of assessment and control technology development.

The AFFSG has put together two draft publications: an oil shale bibliography intended to be a comprehensive list of up-to-date literature for the oil shale industry, and a listing of ongoing shale R&D

projects (including some for which published information is not yet available). Mr. Christianson felt that this represents an excellent attempt to set up a source of contacts, so that communications can be established and followed through, and is an appropriate activity for the Sector Group to undertake. It might be worthwhile expanding this document to serve as a reference list to include other Sector Group areas of interest.

Background

The program involved broad environmental assessments of synthetic fuel from oil shale. The assessment activities are oriented toward evaluation and development of control technology options needed to mitigate adverse environmental impacts from oil shale development. The Cincinnati laboratory has responsibility for the control technology program.

Program Rationale and Environmental Objectives

The overall rationale behind the program is that oil shale is an extremely large national resource, second only to coal in estimated reserves. Assuming that a viable technology can be developed, the United States has an estimated 200 billion barrels of oil recoverable from shale.

Demonstrated extraction technology does exist. Retorting technology is being pursued at large pilot scale almost constantly, depending on the status of the industry and associated activities. That refined shale oil is a usable product has been demonstrated for ships and jet aircraft. Some of these demonstrations, including test results, were discussed at the last Sector Group meeting. So, potentially, oil shale development could lead to considerable industrial activity.

Mr. Christianson mentioned a number of needs and objectives related to oil shale from an environmental standpoint, for which studies are underway. These include solid waste leaching and revegetation studies receiving EPA support. Ambiant air quality is being monitored at leased sites. While not directly funded by EPA, these monitoring efforts represent ongoing studies relating to environmental objectives. EPA is also funding ongoing programs relating to ground water pollution problems.

Although socio-economic impacts are in a somewhat nebulous state, they are causing concern, particularly in EPA's Region VIII, which includes most of the coal and oil shale deposits receiving attention. Boom towns, changing life styles, and related problems are perceived under rapid energy development.

Attempts are underway to describe and mitigate harmful effects of the potential oil shale industry before development occurs at too rapid a rate to allow careful evaluation. Overall objectives include process/environmental evaluation studies, specific discharge characterizations, and evaluation and development of needed control technology.

Program Description

Retorting emissions characterization and control is primarily handled through the Cincinnati Laboratory's contractual effort with TRW/DRI. They are looking at off-gas effluent monitoring, water pollutant identification, and evaluation and/or development of needed controls.

In terms of solid waste activities, the Cincinnati laboratory is managing leaching and revegetation studies through the Resource Extraction and Handling Division, and has several ongoing efforts with Colorado State University (CSU). CSU is investigating the spent shale from various retorting methods as related to erosion and percolation control, and salt, toxics and carcinogenic concentrations in runoff and leachate.

CSU is also evaluating revegetation potential through identification of plant species that can be used to refurbish spent shale piles and provide top soil coverage. They are looking at plant survival under normal rainfall conditions and the concentration of toxics in those plants that may be reestablished. These activities are also being funded by EPA through the Cincinnati laboratory's Resource Extraction and Handling Division.

In the realm of air quality modeling, there are ongoing transport process modeling efforts within EPA for assessing the transport behavior of the emissions. Data is being gathered for input to the types of models under development. These pursuits are not oriented specifically towards oil shale, but are relevant to oil shale technology development.

Factors relating to socio-economic impacts are being pursued primarily through the integrated assessment work related to western energy development, including changes in lifestyle, overloading of existing facilities and land use impacts. As for ground water studies, the leaching and hydrology modeling and stream desalinization is primarily oriented toward the solid waste leaching activities carried out under the aegis of the Cincinnati laboratory, while modeling of possible pollution of underground aquifers is being done under the direction of the Environmental Monitoring and Support Laboratory in Las Vegas. There is a five-year, ongoing program for that underground aquifer modeling effort.

Limitations and Constraints

The oil shale industry has an uncertain financial future, Mr. Christianson stated, and the status of this non-existent industry changes almost daily. There are other complications that must be considered, particularly in regard to the water rights of the Colorado River (the allocation of water rights--who gets what, where and when), which are complicated even more by the variation in the estimates of water requirements for oil shale development. Salinity is also a problem, or at least a potential problem, in terms of leachate runoff and discharges and the ways in which they may affect salinity, which is already a concern in the Colorado River basin.

Program Status

A large-scale regional impact study is being carried out by Radian, along with the University of Oklahoma. This is one of the larger overall assessments.

In addition, there is a study on process evaluations, pollutant characterizations, etc., which is primarily covered by the TRW/DRI effort handled through the Cincinnati laboratory. The project is barely into the second year of a three-year contract. There is a preliminary report in draft assessing the environmental impact from oil shale development that is now being reviewed and revised. It should be close to camera-ready copy by the end of September (1976), and should pull together most factors relating to environmental assessment and potential control technology needs. It will contain in-depth status reports on some of the technologies, their potential impact on the physical environment, some of the refining and end-use implications of shale oil and descriptions of some ongoing monitoring programs. It is hoped that there will be significant output from that effort within a few months.

As part of the TRW activity, a sampling and analysis program was conducted at the Paraho facility by TRW/DRI with close cooperation between Paraho Shale Demonstration, Inc. and ERDA (the federal agency responsible for overseeing oil shale activities on leased federal land) through the Laramie Energy Research Center (LERC). The Paraho facility is leased under such an arrangement. At the Paraho site, both indirect and direct retorting processes were sampled. Sampling locations were selected to best describe the overall process streams, mostly in terms of those that could become waste streams in a full-scale plant or those that could be fed to downstream units that would generate waste streams. A preliminary report has been written, reviewed with the Paraho Corporation and ERDA's Laramie Energy Research Center and the revised document is now in preparation. It will again be put through the entire review process and it is hoped that the final document will be available in a few months. The report incorporates a lot of good information and experience (e.g., how and where to sample), although not as much in the way of quantitative results as had been hoped. Valid quantitative results were obtained in some cases, but in others the operating modes were not typical, or steady state had not been achieved or was not achievable at the time the testing was done. It did provide, however, a good preliminary sampling experience for the processes.

Revegetation and leaching studies have been underway for two years. These programs are slated to run for a total of five years and will cover toxics concentration in relation to vegetation, including evaluation of the effects of natural rainfall and snow melting. Groundwater monitoring and transport models are being developed and tested through

EPA programs for oil shale and for other applications as well. Data from various studies mentioned will be helpful in such development and in verifying models. Air quality models are being developed and tested and meteorological data is being accumulated. Hydrology models under development need the results of leaching and runoff studies from spent shale disposal. The study results will be used to develop overall base lines for these types of model developments.

Problems and Issues

Environmental programs are in a state of relative infancy. There is much work to be done, depending on the industry and how it progresses. There are solid waste disposal problems including possible saline and toxic runoffs or leachate from spent shale. Emissions and discharges must be addressed for all potentially viable processes, at least. The entire program is currently in a state of flux because of an undefined national energy policy and the failure of a Congressional loan guarantee support bill for oil shale. All of this has resulted in several major oil companies delaying, if not withdrawing, their support for oil shale activities. For those who are still interested, costs are escalating. Environmental groups pose many problems. Those interested in a potential oil shale industry should be very careful how they handle this now non-existent industry. Implications downgrading or killing it should not be established before a realistic look is taken at what it is, what it can do and what its impacts are. Problems exist because of the semi-arid environment, the potential water availability and associated pollution potential or possible impacts.

Options for Future Work

Mr. Christianson felt that EPA will probably continue to monitor and support environmental studies and evaluate processes as the industry progresses, depending on the status of the industry or any given process within it. There will be additional work on control technology for in-situ extraction, which is also receiving attention from ERDA and others (e.g., Occidental).

Experimental validation of hydrology and air quality models will have to continue. This involves conducting studies, accumulating data and using the best modeling techniques available, which will be no small task.

Interaction with Other Programs

EPA would like to cooperate as closely as possible with ERDA, the Bureau of Mines, the National Institute for Occupational Safety and Health (NIOSH) and others in activities related to in-situ, development. Due to the overall environmental effects area being in an infancy state, no single group or interest is likely to have the resources or the capability to do all that needs to be done. A coordinated effort would be most effective from the standpoint of both government and industry.

Interaction with regard to other programs depends on future events. EPA is trying to keep current, continue sampling and analysis, and integrate this sampling with environmental assessment and control technology development whenever possible, but at least needs to get data with which to evaluate the environmental implications of various processes. The EPA thrust must depend on the given status of any process at any given time.

Discussion

In the ensuing discussion, Dr. David Coffin of EPA's Health Effects Research Laboratory at Research Triangle Park (RTP) supplemented Mr. Christianson's report by indicating actions that had been carried out or were planned in the health and ecology area, particularly at RTP and Gulf Breeze. He reiterated the industry being considered is a developing one, and commenting on its current state of flux, said that it seemed that it would be very desirable to get into a developing industry before huge capital investments were made so that serious toxicological problems which might arise could be obviated. At this time, problems involving carcinogenesis and some phases of water ecology are underway. The water ecology program is being conducted at Gulf Breeze.

The greatest problem encountered to date has been that of obtaining specimens. As a result, evaluation of the biological aspects is somewhat out of phase with the engineering. There is an effort underway to set up a cooperative program with ERDA and NIOSH, and possibly other government agencies, for a materials repository for various forms of energy products including (but not limited to) shale. The site will probably be established at Oak Ridge. He indicated that the only shale products they have been able to obtain thus far have been some Navy-controlled materials contributed by LCDR Leigh Doptis. They are being examined from the standpoint of product carcinogenicity and, although it might not be considered part of EPA's responsibility, it is the only material available. Hopefully, in the next phase they will be able to look at effluents--sidestream and final--of shale oil combustion products.

Ecologically, the Gulf Breeze group would like to be able to look at what might happen should shale oil products (some final products, e.g., gasoline, diesel, and jet fuel as well as crude) be spilled into estuaries or the open seas during transportation. They are looking at possible effects on marine animals, and also the influence on humans through the food chain.

In answer to a question, Dr. Coffin indicated that the repository was intended to serve two purposes: to provide standard reference materials on samples, and to store a sufficient number of samples to allow a number of investigators (from various interested agencies) to work with the same materials.

Dr. Coffin later informed the group of a USSR/USA cooperative agreement program. He, Roy Albert of EPA, Bill Wagner of NIOSH, and Mick Carter of ERDA recently made up a delegation to Estonia to discuss health effects problems related to shale and oil shale development, as part of the preliminary stages of the project. Shale oil development in Estonia, which began in 1945, is now a sizeable and viable industry in the Soviet Union, supplying most of the electric power to the city of Leningrad and its environs. The delegation did not view any of the processes--they were invited for health discussions only--but they were told that about two-thirds of the shale is directly incinerated for production of power and about one-third is retorted underground. The Soviets were concerned with health effects and have collected some data on a chronic pulmonary disease apparently related to the dust. They have also looked at the carcinogenic content of both their shale and the products. Their oils apparently contain a large amount of phenols, so they are investigating their effects. Other areas of concern are lung cancer in an epidemiological situation and ash revegetation studies. Dr. Coffin and Bill Wagner hope to return in January to survey the plants and identify the points at which there is human contact with the various effluents, so that health studies can be planned.

During the discussion it was indicated that the European shale is 2-3 times as rich; therefore, there are doubts as to the transferability of the technology. The status of direct combustion of oil shale was brought up--whether or not it was in the process development stage. Dr. Coffin answered that the tentative agreement called for an exchange of products which would permit us to determine the potential for technology transfer.

Dr. Coffin indicated that the funding level for the TRW three-year effort (about $1M) might not be adequate to cover field sampling and analysis since such activity had not been planned initially.

General Discussion

Dr. Foley opened the floor to discussion of the presentations on Advanced Oil Processing (CAFB and Desulfurization/Demetallization/Denitrification) and Oil Shale, saying that they summarized EPA's work in the oil and oil shale area. In the oil area, EPA is looking for alternative techniques to flue gas desulfurization and for control of emissions from the combustion of the oil products. One of the technologies being considered is the CAFB process which is a two-stage combustion-type of system. The gasifier feeds directly into an existing boiler as a retrofit to clean the very dirty high-sulfur oils. EPA is also interested in methods of removing pollutants from fuel prior to combustion, and would like industry's opinion as to the viability of these areas of study.*

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* During informal discussions between Sector Group members at meeting break periods, it was noted that IRS determination of what is and what is not considered environmental improvements could have a major impact. Tax incentives at the present time are provided only for post-treatment efforts (i.e., treatment of effluents), not for pretreatment efforts (e.g., coal cleaning).

In-Situ Studies

In the oil shale area, EPA intends to carry out environmental studies related to some of the in-situ processes. Normally, in studying the environmental problems posed by a process, there are pipes or stacks or vents--something from which or where direct measurements can be made. EPA is interested in suggestions as to methods and approaches to environmental measurements for in-situ processes.

What needs to be done by any one agency should reflect the ongoing work in other agencies. ERDA and the Department of the Interior are both working in the in-situ area. Activities that span many Federal agencies should be coordinated to avoid the appearance of duplication of effort.

ERDA is the focal point for developing environmentally sound technology and EPA is the focal point for environmental assessments of technologies that have been developed by others. EPA and ERDA must also be cognizant of the many active interest groups.

ERDA has been taking environmental measurements on in-situ gasification and in the areas of water and air characterization. ERDA is also required to prepare environmental impact statements, and set requirements for permits and other approvals. They must do environmental studies to support these activities as well as to assure that their process is environmentally sound.

EPA needs to develop a data base to provide information to the different programs in EPA that can use the data as well as to provide an independent perspective to advise ERDA of EPA's viewpoint. NIOSH's regulatory role is very similar to EPA's, but has a different legislative base. They need very similar data (though it differs to some extent), in order to perform their roles and advise ERDA.

With regard to oil shale and in-situ processing of oil shale, EPA, ERDA and NIOSH are trying to draw up appropriate memoranda of understanding, protocols or agreements to facilitate the development of joint programs where possible. From the EPA standpoint, at least in the control technology area, it is desirable to define the limits of the in-situ process in order to identify the process emission and effluents.

In developing this cooperative program it seems worthwhile to put the basic program together and circulate it for review by industry and supporting users and request feedback before the program is finalized.

Foreign Plant Characteristics and Considerations

The Yugoslav gasifier has a water waste stream which is through an open sewer into the river. The water that is condensed out of the outlet of the gasifier runs through a phenol solvent plant that removes phenols and some hydrocarbons, and then goes into the sewer. The system operates much better than had been projected in the design stage. There is also an ash quench system in which the hot ash comes out of the bottom of the gasifier and simply drops into the sewer (releasing a large quantity of fugitive emissions). This joins the water from the phenol solvent unit and flows down to the river. It is a poorly designed process from the water pollution control point of view. They do have a biox unit, which is not being used because they do not think it is needed as yet. The plant is currently running at less than half capacity because of the lack of demand for their product. When they are running near capacity, they will probably use the biox unit. EPA intends to make a very thorough measurement of the contents of the stream.

The South African gasification plant was visited by an EPA team about a year and a half ago. It is a very large process, technically better staffed than any of the others, with a good deal of environmental control technology. It is probably the best run of the foreign gasification plants. Their water treatment plant is very good, but it still may not be acceptable by U.S. standards. Their data has been made available to industry, but not to the U.S. government as yet.

D. Chemical Coal Cleaning--Mr. Kelly Janes

Mr. Kelly Janes, Chief of the Fuel Processing Branch of the Department of Energy Assessment, Control Division, IERL-RTP, began by explaining that within EPA, the Cincinnati laboratory is responsible for the problems associated with extraction of coal as well as other fossil fuels, while the Research Triangle Park laboratory's responsibility begins after the coal is mined, in the coal cleaning treatment area. The Coal Cleaning Program is based on three areas of concern—the technological development of the process or processes, environmental assessment and environmental control development. It differs from the rest of the EPA synthetic fuels programs, because it involves responsibility for development of basic technology.

Objectives and Rationale

The objective is to develop, and/or aid in developing, chemical coal cleaning techniques for removing sulfur and other contaminants from coal in a way that is environmentally sound. The rationale behind the development of chemical coal cleaning is to increase the size of U.S. coal resources; meet emission regulations (Federal, state and local); and develop methods of producing a clean fuel for what EPA calls area sources (the smaller user who, due to cost or size, would probably be unable to use other techniques such as flue gas desulfurization, gasification or conversion).

Program objectives include environmental assessment and control technology development for chemical coal cleaning processes--to include those developed by other organizations as well as those developed by EPA. Other objectives are the development of environmentally sound processes that would comply with emission and discharge regulations, identification of streams and compounds that would have adverse health and ecological effects and development of emission guidelines based on estimated permissible concentrations of compounds. These estimated permissible concentrations would be based on health and ecological effects, and would be guidelines that developers could use in trying to determine whether a process is environmentally sound or environmentally controlled. These would not be based on best practice or best available control, but on potential estimates--at the limit, based on health effects. The program would also determine the composition of solid, liquid and gaseous discharges from chemical coal cleaning technologies.

Program Description

The program will involve the study of residues from an environmental point of view, residuals from chemical coal cleaning processes and potential problems and restrictions on the utilization of chemically cleaned coals.

In the Meyers process, the largest process development, the reactor test unit (RTU) should be started up early in 1977. Some construction work has already begun. Concurrent with the Meyers process, would be the bench scale support and applicability studies. In any type of power plant unit, it is useful to have a small unit to do exploratory problem solving, rather than trying to do everything in the larger unit.

Study of the flash desulfurization process, a treatment of coal which uses a sulfur acceptor in a fluid bed (FB) reactor, is ongoing at the Institute of Gas Technology (IGT) in Chicago. Final determination of this process's potential has not yet been made.

Some work in the use of microwave energy has been initiated with General Electric of Philadelphia, taking a look at techniques that were highly visible about 10 years ago to see if technologies have developed to a point where they may have greater potential applicability now.

Battelle Laboratories in Columbus is proceeding with work on their hydrothermal process. The initial work involved looking at the effects of process variables on product utilization--composition effects on emissions, etc.--and other types of application studies.

Figure 5, page 40, is an artist conception of what a Meyers process installation will look like. It has the standard ingredients of an extractor, filter, washers, purifiers, sulfur removers, driers, etc. Basically it is Battelle's hydrothermal coal process, on which a good deal of published information is available.

Limitations and Constraints

The size of the resource base and how it can be affected to meet present and future regulations is the basic goal of the technology development. Mr. Janes pointed out that especially in the coal burning, it is very difficult to interface with area source users because they have no concentrated group R&D effort. EPA is considering both industrial and commercial users for whom this process may have an exceptionally high use potential, but communication is difficult since they are individuals, with little or no organizational affiliation.

In the past, there has been a lack of interest in providing financial support for coal cleaning R&D programs especially in the chemical area. Before industry's uncertainty can be evaluated, the cost of coal cleaning must be defined.

Status of the Program

Environmental assessment programs have been initiated and control technology development is underway in various areas. Construction on the Meyers RTU unit has begun. Some construction has been started with the money that TRW was putting into site preparation, utilities, etc.

Mr. Janes indicated that EPA will continue flash desulfurization experiments for a while to try to determine its real potential and its problems. Evaluations of other techniques are also underway. These include techniques being developed and other types of chemistries, to see if there are better methods of removing contaminants and ranges of contaminants, e.g., sulfur and nitrogen.

State-of-the-art background documents are being prepared. Some, especially the one on chemical coal cleaning, are close to final draft form.

Problems and Issues

In regard to a technology such as the Meyers process, economics are always a concern. The cost analysis results vary from $12 to $16/ton.

Some of the main items in that cost are the leaching, regeneration and dewatering/drying (which is a separate problem). It is hoped that the reactor test unit will help to alleviate the uncertainties in some of these areas. Of course, there are also solid waste and gaseous SO_2 disposal problems. Both the EPA laboratory and TRW have looked independently at several systems that seemed potentially viable. The problem appears to be a little less severe than those associated with solid waste programs from some of the other control systems. Of course, the availability of suitable coal that, when cleaned, will meet the required regulations is always a factor.

Economics is probably the main problem in flash desulfurization according to Mr. Janes. There is concern about emissions and other potentially hazardous products that could be present but unidentified.

The issues are more program than technology based. Should there be an increased emphasis on chemical coal cleaning processes? Is there a need to address area source control, i.e., is there enough interest to justify giving it a program priority and increased funding? Is chemically cleaned coal of interest to the utility sector? Would the utility sector ever consider using this type of technique? Should chemical coal cleaning processes be considered for conversion technology? These are questions the developers must consider. The attributes of combining physical and chemical coal cleaning should be considered--using chemical cleaning where physical cleaning does a poor job, as with fine particle coal.

Options for Future Work

One option, certainly, is to complete the pilot unit of the Meyers process plant in California by adding to the RTU. The unit is now confined to leaching and regeneration. All the operations after that—dewatering, drying, sulfur removal—will be simulated in the laboratory using samples from the RTU. If the present program achieves the goals expected of it, that will have to be considered very seriously. If the potential to scale up the demonstration is there, the RTU unit can be used to further define applicability, costs and design data. Mr. Janes felt that this is an area in which the industrial utility segment could be extremely supportive using the test unit to identify and solve some of their own problems.

Environmental evaluations could continue for the Battelle hydrothermal process and some work should also support improved process technology to reduce costs and/or environmental problems, but alternative technologies should be scaled up.

Interactions with Other Programs

The chemical coal cleaning program will be appraised for the benefit of the health and ecological effects group, regional programs and standards development groups in EPA. It interfaces frequently with other government agencies, particularly the U.S. Bureau of Mines process development group, funding most of their physical and some of their chemical work. There are cooperative sampling programs with OSHA/NIOSH and program personnel solicit interest in joint development programs from the industrial segment.

Discussion

There was considerable discussion of Mr. Janes' presentation which included completion of the Meyers pilot unit, the EPA/ERDA Cooperative Coal Cleaning Program, conversion techniques, comparative costs of the available processes, nitrogen intensification problems, information available on existing technologies and microwave energy.

Completion of the Meyers Pilot Unit

If the data gathering evaluation from the RTU supports the hypothesis that the leach time can be reduced to cut costs, a recommendation will probably be made to go ahead and complete the rest of the pilot unit. Funding may be a problem, since the program is in competition for EPA funds. If the results show a significant decrease in costs and hold-up time and more effective processing, the laboratory would seriously recommend complete construction of the pilot facility. The degree of interest or lack of interest in the industrial segment would also influence such a decision.

The opinion was expressed that the bulk of the funding for pilot plant construction should really come from the Bureau of Mines or some other agency not EPA, and that EPA should be in a position to concentrate on assessment of the environmental aspects of this technology.

In response, it was indicated that for the past 10 years, little has been spent by the coal industry or the Bureau of Mines to support this type of activity and that it is difficult to generate interest in this sort of program. There is little incentive for coal producers to fund such testing, since the cost of any additional cleaning would have to be added to the cost of the coal, and users will buy the cheapest coal they can get that will meet regulations. *

EPA/ERDA Cooperative Coal Cleaning Program

EPA has only one cooperative program with ERDA's Environment and Safety group which is through the Los Alamos Scientific Laboratory and addresses waste disposal. ERDA is not very active in the area of coal preparation. This is the result of a decision that was made when ERDA legislation was drawn up, e.g., coal preparation would remain the province of the Department of the Interior.

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* Note that this may also be the result of adverse tax rulings.

Conversion Techniques

Some of ERDA's combustion work, their fluidized bed work, magnetohydrodynamics (MHD) work, etc., could be considered conversion, but ERDA has not indicated thus far that they are interested in pursuing physical or generic types of coal cleaning development.

Comparative Costs

The Meyers process is, apparently, significantly less costly than Battelle's process. However, the processes themselves are not really comparable, since the Meyers process operates at atmospheric, ambient conditions, whereas Battelle's has been geared toward high temperature and pressure studies.

Some attempts have been made to measure the economics of the process to compare it with other alternatives. The Meyers process is competitive with flue gas desulfurization. Chemical coal cleaning should be much cheaper for the smaller industrial or commercial user, due to the comparative escalation of the cost of flue gas control technology as user size decreases.

Nitrogen Intensification Problems

Concern was expressed with regard to the potential for nitrogen intensification in fuel as a result of removing other materials, which could lead to combustion problems. It was pointed out that it is important that consideration be given to the compatibility of cleaning process products with conventional boilers. Clean fuels involve much more than simply sulfur removal, such as increase in the fuel's nitrogen content.

Technology Information

Battelle should have a background report which contains published information on all the so-called chemical coal cleaning technologies around the world.

Microwave Energy

Microwave energy is the induction of a high level energy in the coal through use of microwaves. It is just like heating hot dogs. The pyrites seem to be very sensitive to microwave energy whereas carbon is not. A lot of work has been done in this area. The volatile part of the pyrite can be easily released with microwave energy. GE reviewed other work that had been done and found that in their laboratory samples they were getting pyrite along with some organic sulfur. There is still the problem of analyzing the sulfur types—one may ask whether it is really organic sulfur that is being released or is it only that pyritic sulfur is being attached in the process?

E. Synthetic Fuels Environmental Assessment--Mr. William Rhodes

Dr. Foley reintroduced Mr. William Rhodes, Program Manager, Synthetic Fuels, OEMI/IERL-RTP to discuss the environmental assessment aspects of synthetic fuels.

The environmental assessment for the coal synthetic fuels program consists of three main areas: coal liquefaction, low-Btu coal gasification and high-Btu coal gasification. Each is the subject of a prime contract that has been or is about to be awarded. Hittman Associates, Inc. is the prime contractor for the liquefaction area and Radian Corporation for low-Btu. The high-Btu proposals are currently being reviewed.

Objectives and Rationale

The objectives of the program are to:

- Characterize and quantify the environmental impacts of synthetic fuel technology,
- Determine the applicability and effectiveness of available control technology and
- Identify needed new control technology.

The United States has initiated a large scale program to accelerate commercialization of synthetic fuels from coal. This developing technology is known to have some adverse health and environmental effects, the seriousness of which are, in many cases, yet to be determined. It is EPA's responsibility to insure that the synthetic fuels industry, as it develops, will be environmentally sound.

Figure 9 illustrates the pattern that synthetic fuels growth may take compared to the growth in petroleum refineries since 1950. Figure 10 shows the projected energy funding taken from the Project Independence Report, which is now somewhat outdated. The upper curve should probably be displaced by a factor of 10 upward, and Mr. Rhodes thought that in light of potential investment in that area, the dollars spent for research into the technology development and the environmental assessment and controls are certainly not in excess.

Environmental Objectives

The environmental objectives of the various contractual areas are to: determine the compositions of solid, liquid and gaseous discharges from synthetic fuel plants or processes; identify streams and compounds that would have adverse health, ecological or terrestrial effects; assess alternative technologies and control technologies; develop cost effects of some of the alternative controls; identify process modifications to eliminate undesirable discharge streams or reduce them; eliminate or reduce specific components in the discharge streams, and develop emission guidelines based on estimated permissible concentrations which, in turn, could be based on health or ecological effects.

Program Description

The assessment consists of: review of the current technology and background, acquisition of environmental data, characterization of feedstocks for the purpose of determining the potential pollutants being introduced into the process and development of environmental objectives (based on the effects of local and national standards and

Figure 9

Comparison of Petroleum Refinery Growth and Projected Synthetic Fuel Growth

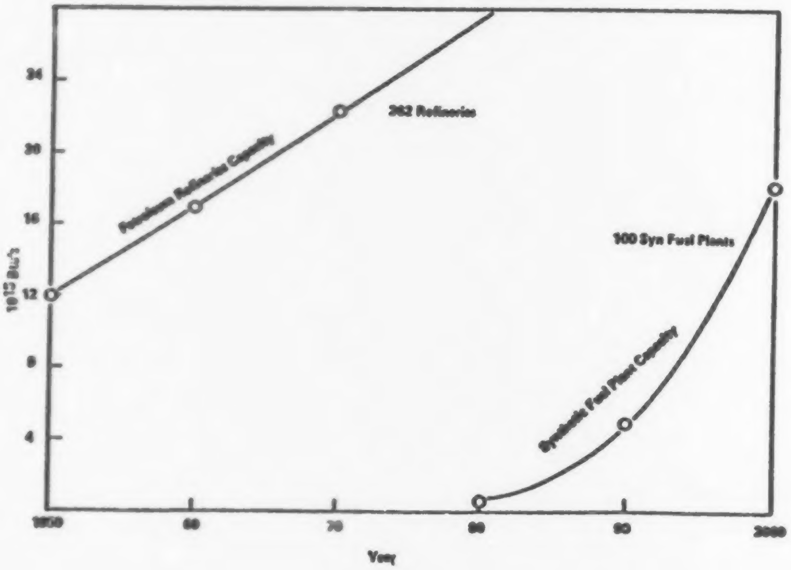
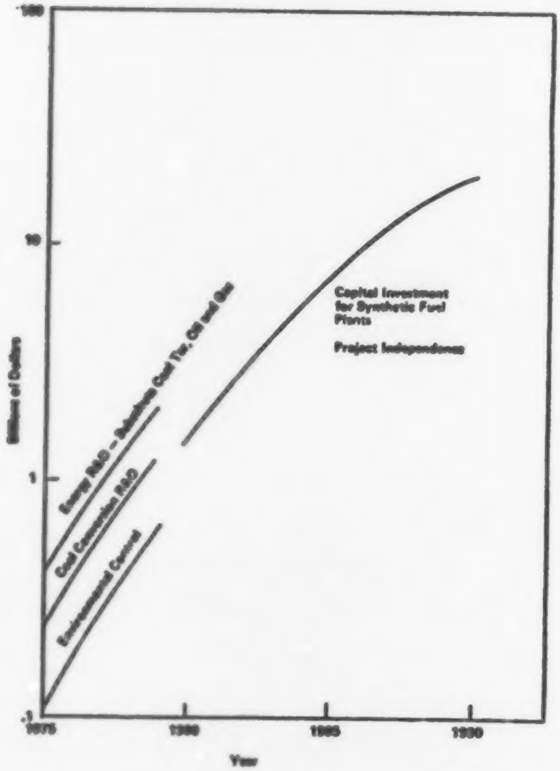


Figure 10

Projected Energy Funding



estimated permissible concentrations), control technology state-of-the-art, engineering and cost analysis, and environmental analysis.

Limitations and Constraints

The United States has a very limited number of commercial plants. Pilot plant operations represent emerging technologies where data acquisition may be less reliable than for more established technologies because of the array of unit operations and the fluctuations that are involved in investigating various experimental conditions that may differ considerably from commercial conditions.

The environmental and potential health effects are relatively undefined, thus providing a moving or almost invisible target for various goals. Although the commercialization timetable has been accelerated, U.S. commerical technology is not yet well defined and data acquisition sites are scarce.

There has been some effort put into locating foreign data acquisition sites and determining whether the owners and their countries would be willing to cooperate in a program to support U. S. assessment efforts. Some of these sites are the Yugoslav plant, the SASOL complex in South Africa, a gasification plant in Kutahya, Turkey and a Lurgi plant in Westfield, Scotland.

Program Status

Engineering analysis and technology background are well advanced. In the Yugoslav gasification plant, the data acquisition and planning for analyses of streams and products has been initiated. At Research Triangle Park, N.C. a bench scale system for problem identification and quantification of pollutants is under development.

Evaluations of environmental impact statements (EIS) and proposed EPA gasification plant standards are now being conducted. Some of the problems result from the general lack of hard data on plant emissions, the high cost of sampling and analysis for both chemical and health effects, incomplete data on the health, ecological and terrestrial effects, a lack of data on transport fate and reactions of pollutants and a lack of test opportunities in the United States.

One issue Mr. Rhodes identified as causing concern is the degree to which coal hydrogenation products and their residuals are hazardous. Obviously, the answer to this will affect the level of effort for assessment in this area as well as the direction of the associated control technology development.

An associated issue is whether or not development efforts should be aimed at indirect liquefaction and high temperature gasification processes since they may be environmentally safer.

Level of Control

Potential goals in relation to control range from simple compliance with current emission standards using effluent guidelines and/or best available control technology to meeting a zero discharge criterion. Between these extremes, compliance with current or proposed ambient standards or controls at some level below the estimated permissible ambient concentrations which could be based on health effects might be required.

Options for Future Work

Future work options involve consideration of increasing sampling and analysis efforts at bench scale level, foreign data acquisition activities, engineering evaluations based on ERDA and developers' reports and data, data acquisition on pilot plant facilities and technology transfer to potential users.

Interactions with Other Programs

Within EPA, the Synthetic Fuels Program provides samples and associated data to the Health and Environmental Effects Program. There is also interaction with regional programs. Recommendations on control and disposal options, based on what are felt to be best practices, are supplied to the standards development area.

Sampling and analyses of pilot operations as well as environmental programs for the demonstration programs are provided to ERDA and OSHA/NIOSH in cooperative sampling programs.

Industry has a great deal of expertise that could be utilized. The Synfuels Program would like to take advantage of joint programs among interested groups whenever possible.

Discussion

Information brought out during discussions subsequent to Mr. Rhodes' presentation included the following topics.

Pollutant Research: Bench Scale and Pilot Plant Considerations

EPA's pollutant identification and evaluation project would utilize non-isothermal kinetics in studying coal reactions to determine, through use of a programmed temperature-time profile, the pollutants that might be generated first in gasification and later in liquefaction processes. The project will not be totally in-house but will probably be based on a grant to an institution and thus will not be located within EPA laboratories or facilities.

It was noted that NIOSH has expressed concern with a considerable amount of the industrial health data from some of the pilot facilities because they believe it to be atypical, and therefore, not fully adequate for use in addressing industrial hygiene problems.

ERDA's main concern in relation to pilot plant operation is to be certain that the product is satisfactory when operating under environmentally acceptable conditions. Based on the timing and resources required, they believe they may have to somewhat minimize the excursions in which only the generated environmental pollutants would be affected.

One problem with pilot plants is that by the time the process is on line, the plant has become inflexible with regard to operating conditions. Therefore, it is worthwhile to be able to re-evaluate by varying conditions over a very wide range, even wider than normal, to find out if, in fact, one can build a better process. Bench scale facilities are intended to be very flexible so that many different temperature/pressure conditions can be studied under strictly controlled conditions as opposed to a pilot plant where conditions are changed, for the most part, to optimize product outputs rather than for study of environmental concerns.

Foreign Technology Evaluation

SASOL, with 20 years of operating data, is a gold mine that should be tapped. If it is not possible government-to-government for political reasons, perhaps a joint government-industry approach could be taken. Some U.S. industrial groups have direct and politically free access to SASOL information.

It was generally agreed that the acquisition of information from foreign operations is highly desirable and worthwhile. EPA has discussed participating with NIOSH in a joint program to explore health data as well as environmental data with foreign operations, but NIOSH's specific interests have not as yet been delineated.

It was pointed out that EPA is not interested in simply getting samples. It is also necessary that ERDA, EPA and the developers cooperate, not only in obtaining samples, but also in planning to obtain and utilize them. The need for cooperation should not be underestimated--something has to be worked out that is generally believed in by all the parties concerned if the programs are to be worthwhile. The main questions in a cooperative effort are what are the mechanisms for doing it and what kind of data are being sought.

It was suggested that an appropriate model for this sort of program might be the USA/USSR Interagency's International Program, in which NIOSH is active. Assessments of the plants are to be made to determine where health effects should be studied, how to interact with the working populations, etc. This offers a precedent for interaction among ERDA, EPA and NIOSH which could be spread to other programs relatively easily.

Major ERDA Activities

ERDA has three major activities underway relating to environmental assessments of coal synthetic fuels. First, a draft environmental impact statement was published in January 1976 for the synthetic fuels commercialization program. The statement addresses a number of different processes, the impacts of a single plant, and various ways to structure the initial phase of the program. Second, an environmental assessment for the first fossil fuel demonstration plant was prepared, and finally, as announced in the June 20, 1976 Federal Register, a draft EIS is being prepared for ERDA's entire R&D program that goes beyond synthetic fuels to address direct combustion and other components of the full program. A large part of the EIS will be related to synthetic fuels and will have the latest information available characterizing emissions from ERDA's pilot plants.

F. Synthetic Fuels Control Technology Development--Mr. Kelly Janes

Mr. Kelly Janes then presented the Control Technology Development Program for synthetic fuels.

Background

The control technology and environmental assessment programs together make up the Synthetic Fuels Control Technology Development Program. Mr. Janes emphasized that these are not isolated programs, but an integrated group. The assessment program covers high- and low-Btu gasification and liquefaction. In the control development area, the program has been split into areas of control technology that are considered to have some degree of general applicability to any conversion technology. These are water and waste management, fugitive emissions and coal treatment and feeding; converter output, cleanup and purification; and generated products and byproducts. Prime contractors (60,000 man hours over three years) will take the lead in developing centers of expertise to study these areas. None of the contracts have as yet been signed, but two are in final negotiations and the third is nearing the final negotiation stage.

Objectives of the Program

The program has been established to evaluate and modify existing control techniques for applicability and effectiveness, develop new, improved control techniques as requirements are identified by environmental assessment programs, and perform engineering and cost analyses of alternative control techniques. EPA does not assume that it has sole responsibility for control development.

EPA does have a responsibility to ensure that control techniques will be available for the development of an environmentally sound synthetic fuels industry, to provide support and information for the setting of standards or regulations, and to assure that control technology development does not result in increased adverse effects.

Some of the environmental objectives are very similar to those in the assessment area. They include identification of the compositions of solid, liquid and gaseous discharges from synthetic fuel processes, identification of streams and compounds that would have adverse health or ecological effects, environmental assessment of alternative control technologies, and development of cost effectiveness of alternative control techniques of process modifications to eliminate undesirable discharge streams or components.

Program Description

As a starting point, the initial activity under the program is that of considering the current technology background of available controls. An engineering and cost analysis of alternative controls has been initiated, and the development of new/improved control techniques required for advanced processes are now in either planning or development stages. Test facilities for evaluation of existing and new control technologies and identification of emission/discharge problems are major elements of the program.

Constraints and Limitations

The constraints are very similar to those affecting the Environmental Assessment Program. There are no commercial plants in the United States and pilot operations represent emerging technology, with the result that data acquired are open to question as to applicability to full scale production plants. Other constraints are that the environmental and potential health effects are still relatively undefined, the commercialization timetables have been accelerated but are uncertain at best and U.S. commercial technology is certainly not finalized.

Program Status

The R&D is in a very early stage. Evaluation programs of existing technologies are well advanced, but more hard data is required. Again, bench scale systems for control evaluations are under development pursuing two major areas--one is a bench scale facility to study generic raw and acid gas cleanup systems, and another will be set up to begin water treatment studies. There is a high temperature/pressure particulate control program which includes such things as the definition of particle and gas properties and evaluation of various control techniques such as electrostatic precipitators, granular bed filters and novel devices of various types.

Problems and Issues

Problems, once again, are very similar to those of the sister assessment program. Basic technology developers are concentrating on conversion reactor development. There is no concerted effort in the United States to examine controls such as the acid gas clean-up systems, which are basically control units and also the center of most pollutant problems. There is a lack of pilot plant facilities for evaluation of control techniques, and most of the applicable state-of-the-art techniques in existence are also proprietary. The data is therefore difficult to obtain. Development of such controls is very costly, especially with the almost complete lack of data and information on stream pollutants (media, concentrations, toxicities) resulting from application of the control technique.

An important issue is whether a major test facility should be developed for evaluation and development of control techniques that is not tied in with a conversion, gasification or liquefaction development, but is simply a facility designed to develop better control techniques. Should the development effort be aimed at converter technologies with minimum environmental degradation potential or at the technology with the maximum problem potential? This is always a serious consideration. Fixed bed gasifiers tend to have larger potential environmental problems than high temperature gasifiers which eliminate most of the organic materials and tar. Simply stated, the United States must consider whether to develop the systems with the least number of apparent environmental problems or the systems that are the best available (in terms of production) regardless of the number or magnitude of the problems involved.

Options for Future Work

Options under consideration include increased development of bench scale facilities or units, development of pilot plant scale facilities, increased engineering analysis on ERDA and developers' designs and data, and, again, the support of control technique developments with appropriate foreign organizations.

Interactions with Other Programs

Within EPA, the Synfuels Program interfaces with regional programs, the standards development program and various engineering programs. The Synfuels Program is involved in joint control technology work with ERDA in both engineering and pilot plant operations and in cooperative control development programs at OSHA/NIOSH.

Industry could provide a substantial amount of information on control of the main species they are treating. EPA would like to have joint programs with industry in order to utilize their expertise, but again, this is a difficult area because most of their control techniques are proprietary.

Discussion

When the floor was opened for discussion, it centered largely on options for facilities to be used in control technology development.

The possibility of diverting some part of a stream of one of the existing foreign plants for control technology study was brought up as a possible option. Foreign operations have as many environmental problems as the United States, and the personnel involved are well aware of the potential pollution aspects, although they may not be as aggressive as the United States in looking for solutions. There have been opportunities for this type of cooperative effort, but the cost must be considered--putting new technology into an operating plant is extremely expensive. There are also the problems of distance and control. One must, finally, consider whether it is better to invest money in overseas operations, or build a universal test site here in the United States to address these problems.

Control technology will be developed and evaluated on a generic basis rather than on a specific process basis. It has been suggested that it might, perhaps, be most practical to build a small scale piece of control equipment that could be tapped onto existing pilot plants through diversion of a small sidestream on which to perform studies, rather than to perform this function at a bench scale facility. The difficulty is in finding an existing pilot plant that operates for a sufficiently long period to allow control technology studies to be completed. One must also consider whether it is possible to base the study of a control process on a system that has been set up for quite a different purpose. For example, if the pilot plant was intended to study the effects of changing feed rates, temperatures, pressures, etc., the compositions of the stream will vary. Thus, this is an option, but the opportunity has not yet arisen to attempt such a study. It seems preferable to concentrate effort solely on evaluation of control technique development.

There is enough flexibility in bench scale facilities to provide a range of conditions, and therefore allow for the study of a range of gases. Therefore, the controls that are developed will not be uniquely applicable to a particular product, but to other designs and processes as well.

One of the prime reasons EPA prefers to have its own facility, even if at bench scale, is that they can then monitor the effects of the control technology on the stream for any transformations of the waste materials that might take place within the control system itself. The effort is not restricted to the study of an effluent stream or a discharge stream, but can look at the basic chemistry of the system itself, and make correlations based on the stream's temperature, chemistry, etc., identifying pollutants formed or generated and the causes and effects of their generation. It would be helpful if a U.S. commercial system existed so that a sidestream of that system could be utilized for such a study.

In some cases, technology may be examined as it is applied in analogous situations, such as refineries, where some of the streams may have similar characteristics. The Synfuels Program will use any available approach to the study of problems in the absence of large operational facilities in which to examine each potential control system available. The non-hydrothermal facility is applicable to more than the study of the effects of coal conversion. Absorption, and chemical reaction can be studied under very controlled conditions. The resultant data can then be applied to bench scale facilities to see if the correlation of chemistries can be maintained in order to determine what the changes will be if the system is scaled up. Each successive scaling up further clouds the effects of temperature and the array of potential pollutants will probably also change (perhaps not the general constituents, but many of the pollutants of concern). It does offer a mechanism to develop a data base related to correlation potential and the chemistry kinetics of certain materials. Enough information can be obtained to predict the product characteristics and what should be looked for.

In regard to the petroleum industry, so much technical capability exists that a pilot plant is unnecessary. The problem is to obtain information on what the industry is doing. They, potentially, have the base and could identify the problems involved. The petroleum industry is probably the most aggressive and technically oriented industry in the United States.

EPA's bench scale facility for study of the acid gas cleanup system should be operational in eight to nine months. The water treatment facility is expected to be ready much sooner, in six months or less. Pollutant identification and isothermal work should be ongoing in three to four months at an optimum level.

All of the studies discussed are being done through grants, since EPA lacks both the space and the personnel to man such studies.

These facilities will be available for interaction with ERDA. ERDA and EPA have different approaches and objectives for their studies, so there seems to be little likelihood of any great degree of overlap or duplication.

The gas source (for the bench scale facility) will be fluidized bed, since that is the most feasible for bench scale studies. IGT is designing the gasifier to have minimal problems, since the project will not be studying gasification, but potential problems with raw and acid gas cleanup systems.

G. High Temperature/Pressure Particulate Control—Mr. Dennis Drehmel

The next speaker, Mr. Dennis Drehmel, (OEMI/IERL-RTP) discussed high temperature and pressure particulate control. He stressed the difference in structure between the Particulate Technology Branch and other branches at IERL-RTP. The work of the Particulate Technology Branch has been in developing control devices, hence, the branch is not process- but rather device-oriented. It is responsive to the particulate control needs of other parts of the laboratory as well as other organizations.

The program is directed toward the improvement of standard control device efficiency as well as the development of new concepts for the achievement of higher particulate removal efficiencies. The AFF portion of the program activities relates to the areas of fluidized bed combustion, pressurized fluidized bed combustion or coal gasification.

Program Objectives

Mr. Drehmel delineated the program's two main objectives as: (1) to ensure that emissions from advanced energy processes meet future standards, and (2) to develop particulate collection devices which will ensure the success of these processes. The near-term objectives are to develop fundamental information on collection mechanisms of aerosols at high temperature/pressure (HTP) and to determine the environmental and process particulate cleanup requirements. Once this background is established, the objectives are to determine the best way to approach time required is from two to three years (i.e., from development of extension of technique to operational stage). However, if it is necessary to go back to the basic mechanisms, the time required is from three to five years and would not be compatible with ongoing process development. Another constraint is that removal techniques must be compatible with gasification technology or pressurized fluidized bed combustion. There are constraints on size and economics which must be considered. Also, pilot test facilities—even bench scale test facilities of HTP particulate control devices--are very expensive.

Program Status

Primarily, work is at the bench scale, or exploratory level. Verification of the required capabilities of control is ongoing; however, the data in some cases are contradictory. Feedback from manufacturers of turbines indicates that the allowable particulate concentration is a function of the particle size distribution.

An R&D coordination meeting between EPA, ERDA, and appropriate contractors is planned for Fall 1976 in order to examine requirements for technology so that problems may be solved in the most efficient and least duplicative manner possible.

In December, 1976, APT will submit recommendations as to the most effective mechanisms in terms of HTP control.

In the Spring, a meeting will take place between EPA/ERDA personnel in order to consider results both agencies have obtained from various concepts relating to particulate control.

Problems and Issues

The basic issue is that it is not yet clear that the best place to control particulates from a gasifier is at the high temperature/high-pressure portion of the process. There are at least two alternatives:

the problem, find the best path for HTP control, and determine where research emphasis should be placed, in order to get to the demonstration stage as quickly as possible.

The technical objective is to develop particulate control devices which will ensure the environmental acceptability of the advanced processes and maximize efficiency and economy.

Program Description

The evaluation and development of particulate control devices has been going on for some time, including the early stages of HTP. In FY74, funds were allocated to develop HTP (here defined as 1700°F) electrostatic precipitators (ESPs). (Normal precipitators operate at 300-800°F). This work is being carried on by an EPA contractor, Research Cottrell. One project has been completed at MRI on mechanisms for HTP particulate removal. An advanced mechanisms study is being conducted by Air Pollution Technology, Inc., (APT), another EPA contractor. They are to make recommendations as to which mechanisms appear to be the most effective for HTP particulate removal. APT, in addition to the mechanisms study, has a dry scrubber contract. This contract involves a device which allows large spheres to go into the venturi section of a scrubber. The spheres intercept the particles as drops would in an ordinary scrubber. There is a hot filtration contract with Aerotherm to look at metallic and ceramic fabric filtration. A granular bed systems study contract is being negotiated. A ceramic filter contract is underway with Westinghouse to look at ceramic membranes for particulate control.

Constraints and Limitations

Among the constraints and limitations involved, Mr. Drehmel identified the problem of having ample time in which to develop particulate removal techniques which will meet EPA requirements in conjunction with the development of processes that are ongoing (e.g., the Exxon FBC miniplant). If it is possible to utilize devices which are already available, the one is tail-end cleanup of the process; and another is to cool down the gas, clean it, and then reheat it. The latter is equivalent to a low temperature/high pressure particulate removal process. It is difficult to assess trade-offs at this point since the state-of-the-art of HTP particulate control is virtually unknown.

A major concern is that condensibles produce particulates and therefore HTP control by itself may not be sufficient to ensure adequate environmental control.

The other basic issue is how to interact with the process as it already exists. Desulfurization of hot gas is being developed and will involve high temperature particulate removal. Another factor to consider is whether HTP particulate removal will be more suited to some gasifiers than to others or to other processes. A careful evaluation of other programs must be conducted on an ongoing basis since advances in fluidized bed direct combustion might meet current standards and be less expensive than combined-cycle, low-Btu generation. Cooling of product gas before particulate cleanup might be economically attractive, and high temperature particulate removal alone may not prove environmentally acceptable.

Options for Future Work

Options being pursued are as follows. The first major task involves finding economic levels of particulate removal at gasifier exit temperatures: this will be accomplished. Second, EPA/ERDA programs are being coordinated to determine operating conditions and process requirements. The third task is to coordinate with health effects research to determine which requirement drives particulate removal, blade erosion or health. For instance, the indications from turbine manufacturers are that they are worried about particulates greater than two microns in terms of hardware deterioration. From a health standpoint, however, the concern is with two microns and down. Therefore, the interests do not overlap. The situation may exist that although particulates are adequately removed for protection of the turbine, they are not removed to the extent necessary to protect the environment. Fourth, economics must be determined for high temperature versus low temperature particulate removal for gasifiers. This is a major issue which needs clarification.

Interaction with Other Programs

As indicated previously, this program lends support to other areas in IERL and other government agencies.

Discussion

Mr. James Jones (Peabody Coal) inquired as to the status of standards setting for fine particulates. Robert Bauman (EPA/Office of Air Quality Planning & Standards) replied that although chemical analysis research is underway, there is no program to set particulate standards at the present time.

Al Fry (EPA/Policy Planning) asked whether a coordinated program with ERDA exists to study particulate emission when the Reisnel plant's fluidized bed combustor comes on line. Dr. Foley replied that an inter-agency agreement with ERDA/Fossil Energy is being negotiated to become effective next calendar year which would allow agencies to "swap facilities for an equal number of hours" (i.e., the Reisnel plant & EPA's mini-plant).

In reply to a query as to Cottrell's activities under their EPA/IERL contract, Mr. Drehmel stated that an effort is directed at maintaining a stable corona using synthetic gas at high temperatures and pressures.

He also explained activities dealing with the problems of low sulfur fuel. Two years ago it became obvious that in the case of low sulfur coal or cleaned fuels, particulate removal by standard devices such as ESPs will be made more difficult. In order to respond to this difficulty a number of approaches are being considered. One approach is to enlarge the precipitator so that it is possible to collect fly ash from low sulfur coal; however, other types of control devices may then begin to compete. Another approach may be to change the mechanisms of the precipitator to precharge the aerosol so that particulate collection becomes more efficient. The improvement of precipitator technology in the areas of low sulfur and cleaned coals is a major concern.

H. Environmental Process and Effects--Mr. Gerald Rausa

The final speaker, Mr. Gerald Rausa, OEMI, is one of several persons at headquarters working to coordinate EPA health effects research efforts with those of other agencies.

Mr. Rausa stated that the intent of his presentation was to give an overview of the interagency program, indicate general research objectives within the processes and effects categories as well as specific research problems with respect to advanced fossil fuels, inform the audience of accomplishments and difficulties encountered, and entertain suggestions as to possible changes of emphasis in the program.

Background

The Environmental Effects Interagency R&D Program has evolved from a request made of 15 to 18 Federal agencies by the Office of Management and Budget (OMB) and the Council on Environmental Quality (CEQ) to examine the recommendations of the Dixie Lee Ray Report with regard to bringing new energy technologies on line. As a consequence, the King/Muir Committee addressed itself to various categories (such as pollutant characterization, measurement and monitoring) for each technology. The proposed interagency program which evolved was planned as a supplement to ongoing Federal programs.

Interagency Program Areas

The categories addressed by the Interagency R&D Program are: Pollutant Characterization, Measurement and Monitoring; Environmental Transport Processes; Health Effects; Ecological Effects; and Integrated Assessment. The first category was addressed by the Gage and King/Muir Committee and agreement was reached that the characterization of sources would be done within the control technology groups, and pollutant characterization, measurement, and monitoring which concerns itself with field (or as defined within EPA ambient) measurements, would fall under the purview of the Environmental Processes and Effects groups. This is essentially the format followed by EPA programs. However, ERDA's program in pollutant characterization, measurement and monitoring addresses both aspects. Monitoring quality assurance and instrumentation development as well as provision of well-defined materials for calibration of instrumentation are components of this category.

The second category, Environmental Transport Processes, addresses the problems of "rates, routes and reservoirs": the questions of how fast and where the material travels after entering the air, land or water and its ultimate destination and interaction with the target species as well as transformations.

The Health Effects category has been divided into five subcategories. The first is pollutant identification using available techniques. The second involves development of new, more rapid, biological screening systems to evaluate damage. The third addresses metabolism and fate studies--i.e., metabolism in biological systems, test models which are used to evaluate health effects to man. The fourth subcategory--to assess the impact on humans of long-term, low-level exposures--receives the major effort. This requires use of a variety of experiments and approaches including classical toxicological, clinical and epidemiological studies. The fifth category, mechanisms of damage and repair, must be considered in making attempts to extrapolate from animal and other biological data to the ultimate effect on man.

The Ecological Effects Program concerns itself with the impacts on habitats and populations, and the food chain pathway. The environments include fresh water, marine, atmospheric and terrestial.

Integrated Assessment for the Interagency Processes and Effects Program, within EPA, is addressed within the Energy Processes Division of OEMI and, therefore, falls under the administration of the control technology group. The division essentially operates as a program office. Table 3 reflects the FY76 pass-through budget emphasis for the various areas addressed by the Interagency Processes and Effects Program. To date, only 30 percent of the recommended five-year budget of $200 million has been authorized.

Table 3

INTERAGENCY HEALTH AND ECOLOGICAL EFFECTS PROGRAM
ENERGY R&D

(FY-76 RESOURCES: $40,300,000)

AGENCY	MONITORING AND INSTRUMENTATION %	HEALTH EFFECTS %	ECO TRANSPORT AND FATE %	ECO EFFECTS %	TOTAL %
EPA	8.6	15.1	9.7	9.7	43.1
ERDA	1.8	6.9	1.2	3.3	13.2
NIEHS	-	8.0	-	0.5	8.5
NOAA	2.8	-	1.2	3.7	7.7
DOI	-	-	0.1	6.0	6.1
NIOSH	0.9	5.0	-	-	5.9
TVA	0.7	-	0.8	2.9	4.4
USDA	-	-	0.1	3.7	3.8
NBS	2.8	-	-	-	2.8
USGS	2.6	-	-	-	2.6
NASA	1.9	-	-	-	1.9
TOTAL %	22.1	35.0	13.1	29.8	100

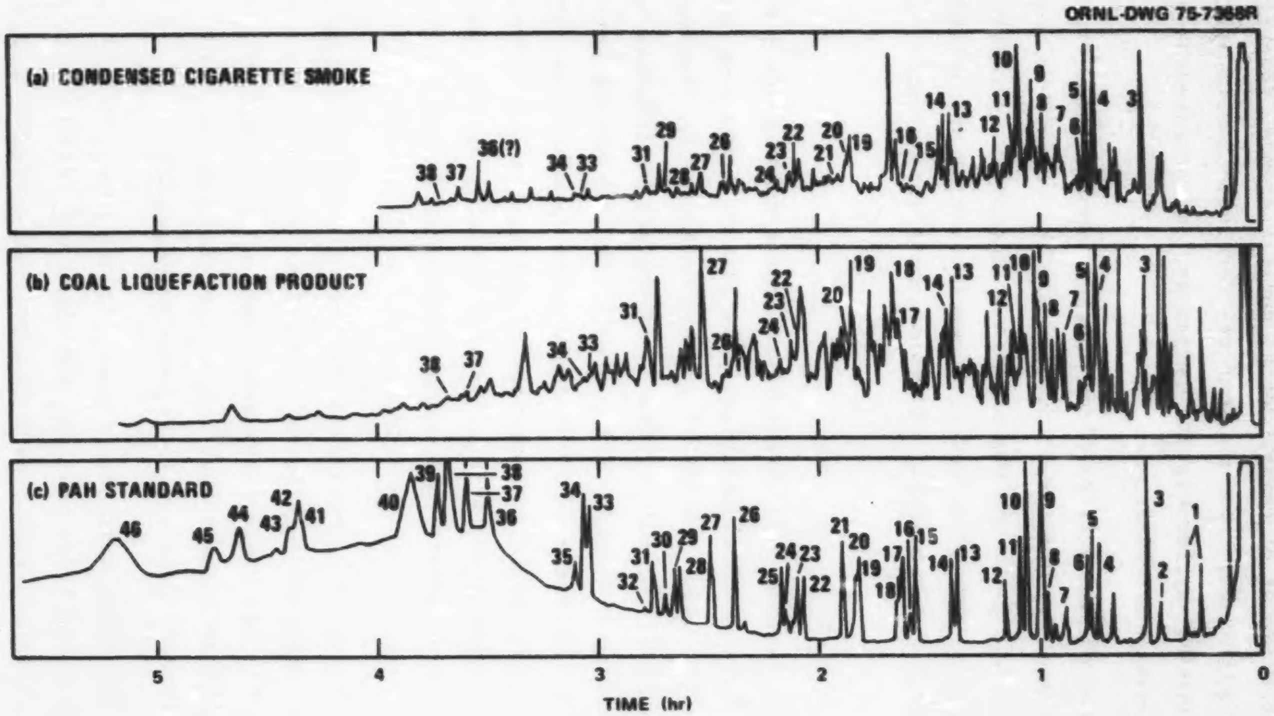
The impact of this program on advanced fossil fuel development will be felt in terms of the emphasis placed in the Processes and Effects Program that is, essentially the same areas of concern as in normal combustion situations, with modification essentially of the spectrum of materials—both in the chemical nature of the pollutants and the magnitude of the emissions. EPA Report No. 650-2-75-038, developed by Radian Corporation, conjectures about what materials might be coming out of AFF facilities. ERDA's base program plan (conversion technology) developed by Oak Ridge National Laboratory, published in May 1976, contains a review which addresses the question of agents not only in terms of conjecture, but indicates actual data. Research Triangle Institute's Report No. 31U-1214, "Identification of Components of Energy Related Waste and Effluents" is another good report in the subject area (specifically R&D in in-situ shale oil).

Problem Areas

Figure 11 (borrowed from an article by Mike Guerin and Jim Esler of Oak Ridge Laboratory) illustrates the complexity of the problem with respect to organics. Each peak represents a different organic component. The top portion of the figure shows the spectrum developed by Oak Ridge in the work associated with analysis of components of cigarette smoke; the middle portion was developed for coal liquefaction products; the third is the spectrum found for polyaromatic hydrocarbon (pAH) standards. This example indicates the difficulties associated with attempting to develop an index of toxicity for materials where many complex variables are involved. The nuclear industry faced similar problems in the area of fission products' varying contributions. The approach they developed might be applied to development of indices which consider synergism of pollutants from the synthetic fuels industry.

Figure 11

Comparison of Organic Compound Spectra



Other problems specific to synthetic fuels characterization, measurement and monitoring include development of more accurate instrumentation, measurement of environmental quality trends, identification of secondary pollutants from new sources, development of a systemati monitoring methodology for organic compounds, and procurement of surrogate standard reference materials.

The transport and fate problems involve transport and transformation of emissions from synthetic fuel processes. The primary concern with regard to advanced fossil fuels are the organics: increased concentration of suspect carcinogenic, mutagenic and teratogenic agents; the metabolic products resulting from the introduction of hydrocarbons into animal food chains.

Program Status

Under the category of characterization/measurement/monitoring, a list of surrogate Standard Reference Materials is being compiled as a joint effort with ERDA's Pacific Northwest Laboratories (contacts: Richard Perkins and Michael Peterson) and the National Bureau of Standards (contact: Phillip LaFleur). EPA contacts for this effort are Mr. Rausa and Dr. Gregory D'Alessio of EPA's Measurement Program. The list is primarily being developed for purposes of calibration of instrumentation rather than for toxicity testing. Table 4 illustrates the recommendations resulting from that effort—compounds, concentration and the bases used. The n-heterocyclics are to be addressed in the future.

Advanced fossil fuel residuals and products are to be characterized chemically and physically. The major portion of this effort has been undertaken by the Oak Ridge contingent, however EPA and ERDA's Pacific Northwest Laboratories have also contributed information. (Mr. Rausa offered to provide references to interested persons.)

A series of experiments are ongoing in the transport and fate area with regard to directional modeling and shale oil adsorption but data is not yet available. With regard to atmospheric transport problems, little attention has been given to addressing transformation of organic materials. A question which has arisen is whether unburned hydrocarbons,

Table 4

SURROGATE STANDARD REFERENCE MATERIALS
1 - 100 PPM

- **POLYNUCLEAR AROMATICS (ORGANIC BASE)**
  - 2 - METHYLNAPHTHALENE
  - BENZO (α) PYRENE
  - CHRYSENE
  - FLOURANTHENE
  - PHENANTHRENE
- **PHENOLS (ORGANIC BASE AND AQUEOUS MEDIUM)**
  - PHENOL
  - P-CRESOL
  - O - CRESOL
  - 1, 3, 5 - TRIMETHYLPHENOL
  - 2 - NAPTHOL
  - CATECHOL
- **N - HETEROCYCLICS**
  - TO BE DETERMINED

together with NO_x could be responsible for production of nitrosoamines--a question which is causing significant concern.

With regard to aquatic transport, the focus of organic studies is essentially nonspecific with a small effort ongoing in the areas of transformation between solubles and particulate materials.

With respect to toxicity in carcinogen-related studies, products have been screened through toxicity and Ames mutagenicity tests using the acid base extraction approach to fractionation. There is a problem, however, in attempting to extrapolate information obtained in this sort of testing to the real world. The health effects aspects of the program are attempting to make such data more meaningful in that sense. For instance, one might expect that there is no discernible difference between sweet crude and syncrude product oils; however, an Ames test has demonstrated that it appears that syncrude is 10 times as mutagenic per unit as sweet crude.

For the past two years a program has been ongoing in the area of carcinogenicity: contributors are EPA, ERDA, NIOSH, and NIEHS. An evaluation of the EPA/ERDA program in health effects research is being coordinated in order to avoid duplication of effort. Table 5 indicates the emphasis of this interagency program. The majority of emphasis is on the hazards analysis (i.e., long-term, low-level dose effects relationships). The identification of hazardous materials does not, however, define the dose-response relationship--it does answer whether there is a response in a given situation. New screening systems may need to be developed which can more adequately predict effects of long-term rather than the classical acute response systems. The metabolism and fate and the mechanisms of damage and repair must be adequately understood in order to extrapolate from animal experiments to human. In determining dose-effects relationships one tries to estimate the risk to the individual. There is risk involved in using dose-effect curves because of the tremendous uncertainty associated with them.

Table 5

CARCINOGEN-RELATED STUDIES FUNDED BY OEMI/EPA INTERAGENCY PROGRAM

(FY 75/76 RESOURCES: 10,991,000)

	EPA FY 75/76 %	*ERDA FY 75/76 %*	*NIOSH FY 75/76 %*	*NIEHS FY 75/76 %*	*TOTAL FY 75/76 %*
IDENTIFICATION OF HAZARDOUS AGENTS	3.6	3.5	-	-	7.1
RAPID BIOLOGICAL SCREENING SYSTEMS	7.6	11.0	-	2.4	21.0
METABOLISM AND FATE	-	-	-	2.0	2.0
HAZARDS ANALYSIS (DOSE-EFFECT)	30.8	12.0	20.6	3.3	66.7
MECHANISMS OF DAMAGE AND REPAIR	-	2.8	-	0.4	3.2

The carcinogen-related program also addresses the questions of inorganics and trace metals. Ongoing activities include chemical dosimetry at both the cellular and organ levels.

An additional activity is ongoing in the area of multiplicity of stressors, e.g., polyaromatic carbons with NO_2 or H_2SO_4. Dave Coffin (HERL-RTP) is a project officer for several such tasks. The activity includes demonstrations of rate effects in some animals (i.e., subacute pulse of a stressor combined with low-level, chronic administration of a carcinogen). Results indicate apparent differences in response. Therefore, it is likely that a single number or rate may not be the only constraint applied on the ambient level. An ambient level consists of a random distribution of a variety of agents being pulsed at different times—that is, the real world situation. However, in the laboratory normally one agent at a time is varied.

In the area of ecological effects, aquatic toxicity studies on zooplankton and fish have been conducted by ERDA and EPA using whole effluents and fractions. Bioaccumulations for both metals and organics have also been undertaken. Food web accumulation and transformation is being undertaken in Gulf Breeze Laboratory. NIEHS is also conducting ecological effects studies.

Problems--Summary

Contractual difficulties present a major problem with respect to the initiation of programs. Another is the procurement of samples in large volumes. Some approaches have failed to answer the question of how to extrapolate information from animal experiments to man and from laboratory models to full-scale facilities (i.e., whether signatures of effluent streams can be understood by conducting small experiments).

Discussion

In reply to a request for further delineation of the program's scope, Mr. Rausa suggested that Dick Laska or he could provide interested persons with an SSIE abstract listing which has been organized according to the five program categories. The listing is a useful referral service although it is not valuable as a management tool.

A suggestion was made that copies of discussion items be distributed prior to the presentation as a guide to aid attendees in following the presentation.

Mr. Rausa asked that ideas as to shift of emphasis and problems not being addressed be submitted since this sort of feedback is a primary purpose of the Sector Group meetings.

As there was no further discussion, the meeting was adjourned.

ATTACHMENT I

AGENDA

ADVANCED FOSSIL FUELS SECTOR GROUP (AFFSG) MEETING

25 August 1976

Environmental Monitoring and Support Laboratory (EMSL)
Las Vegas, Nevada

8:30	Coffee and Registration	
8:45	Welcoming Remarks	Dr. Gary J. Foley, Chairman AFFSG

SESSION I

9:00	Activities Related to Previous Meetings & Discussion	Mr. William N. McCarthy, Jr. & Dr. Gary J. Foley OEMI/Headquarters
9:45	Coffee Break	

SESSION II
EPA/ORD AFF Research and Development Program

10:00	Advanced Oil Processing (CAFB)	Mr. Sam Rakes OEMI/IERL-RTP
10:30	Advanced Oil Processing (Desulfurization/Demetallization/Denitrification)	Mr. William Rhodes OEMI/IERL-RTP
11:00	Oil Shale	Mr. Alden Christianson OEMI/IERL-CINC
11:30	Discussion	Dr. Gary J. Foley OEMI/Headquarters
12:00	Lunch	
1:30	Chemical Coal Cleaning	Mr. Kelly Janes OEMI/IERL-RTP
2:00	Synthetic Fuels Environmental Assessment	Mr. William Rhodes OEMI/IERL-RTP
2:30	Synthetic Fuels Control Technology Development	Mr. Kelly Janes OEMI/IERL-RTP
3:00	High Temperature/Pressure Particulate Treatment	Mr. Dennis Drehmel OEMI/IERL-RTP

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3:30	Coffee Break	
3:40	Environmental Process and Effects	Mr. Gerald Rausa OEMI/Headquarters
4:00	Discussion	Dr. Gary J. Foley OEMI/Headquarters
4:30	Closing Remarks	Dr. Gary J. Foley OEMI/Headquarters
4:45	Walking Tour of Laboratory Facilities	Office of Monitoring & Technical Support's EMSL Staff

ATTACHMENT II

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(Alphabetical Listing by Name)

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